TWENTY-SECOND REPORT OF THE ONTARIO BUREAU OF MINES;

PART I.

1913

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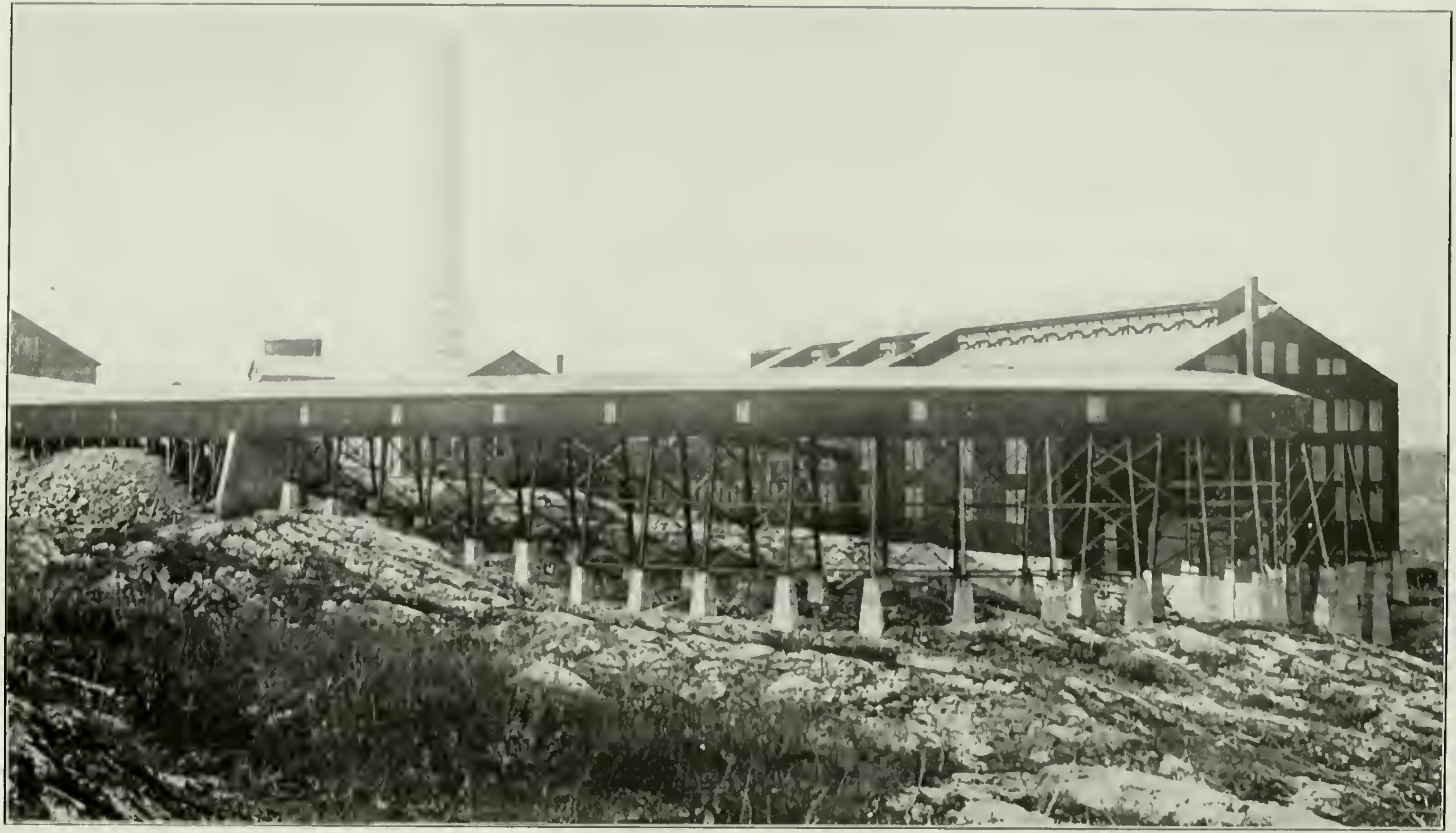

General view of Charge Trestle, Smelter Building and Stack, Mond Nickel Company, Coniston, Ontario

TWENTY-SECOND ANNUAL REPORT

OF THE

BUREAU OF MINES, 1913,

BEING

VOL. XXII., PART I.

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LETTER OF TRANSMISSION

To His Honour Sir John Morison Gibson, Etc., Etc., Etc.,
Lieutenant-Governor of the Province of Ontario.

Sir,— I have the honour to transmit herewith, for presentation to the Legislative Assembly of the Province of Ontario, the Twenty-second Annual Report of the Bureau of Mines.

I have the honour to be, Sir,

Your obedient servant,

W. H. Hearst,
Minister of Lands, Forests and Mines.

Department of Lands, Forests and Mines.
Toronto, 16th April, 1913.

INTRODUCTORY LETTER

To The Honourable William Howard Hearst,
Minister of Lands, Forests and Mines.

Sir,—I beg to submit to you, for transmission to His Honour the Lieutenant-Governor in Council, the Twenty-second Annual Report of the Bureau of Mines, the same consisting of two Parts.

Part I contains the customary review of the mining industry of the Province, dealing with the progress and developments of the year 1912, and presenting as far as possible the salient facts in a series of tables.

It is gratifying to be able again to report that the past year was the most productive the industry has yet experienced. The output of the mines and mineral works for the year had a spot value of $48,341,612, which was $6,364,815, or fifteen per cent. more than that of 1911, previously the largest on record.

All the metallic products showed an advance in value, some of them very considerable advances, the sole exception being iron ore, shipments of which were smaller than for some years past. The silver mines of Cobalt continue to yield their riches, the small decline in production being more than offset by the higher value; the nickel-copper mines of Sudbury were worked on a more extensive scale than ever; and the gold fields of Porcupine gave a substantial earnest of their future by turning out one and three quarter million dollars' worth of bullion.

In the non-metallic list there was also an increase in value, but of smaller proportions, being about five per cent. The items on this list from year to year show more or less fluctuation. Brick and stone, among the construction materials, were last year produced in larger quantities, while Portland cement and lime were less in value; petroleum once more showed a smaller production, and natural gas a larger. Feldspar and iron pyrites were below the level of 1911; corundum, graphite, gypsum and quartz were above.

On the whole, it may be confidently stated that 1912 was the best year yet in the Ontario mining industry.

The statistical review also gives the revenue derived by the Government from sale and lease of mining lands, and from profit, acreage and gas taxes, royalties, etc., and deals with the work of the Mining Recorders, Provincial Assay Office, etc.

The mines ot Ontario are described by Mr. E. T. Corkill, Chief Inspector ot Mines, who gives details of the plants and workings. Mr. Corkill also makes report on the accidents which occurred during the year in the mines, quarries and metallurgical works. The statistics concerning such accidents reveal little or no improvement over previous years. The casualties which kill or maim so many of the men engaged in mining in Ontario are too numerous, and this feature is far from making a showing upon which the industry can be congratulated.

The geology of the Whiskey Lake and Massey Copper Mine areas is briefly described by Dr. A. P. Coleman. In the former a number of copper sulphide outcroppings have been discovered, but none have ever yet been worked to such an extent as to show their size or continuity, or to prove the value of the district as a whole. In the latter area two mines at least were worked with considerable perseverance, but both are now, and have been for some time, closed down.

When the District of Patricia was handed over to Ontario by the Government of Canada, this Province was given terminal facilities for a railway at the mouth of the Nelson river, within the territory allotted to the Province of Manitoba, and in May, 1912, Mr. J. B. Tyrrell, under your directions, proceeded to Fort Nelson for the purpose of locating and surveying the lands required. On his return journey Mr. Tyrrell and party came through the District of Patricia by the Severn River Route, and under the title "Hudson Bay Exploration Expedition, 1912" he gives an account of his work and of the geological, agricultural and other features in part of the newly acquired territory, which will be read with considerable interest.

Mr. A. L. Parsons deals with the Lake of the Woods and other Mineral Areas in the northwestern part of Ontario, his work being a continuation of that done by him in previous seasons for the Bureau.

A brief article by Mr. R. B. Stewart on the West Shining Tree Gold Area, gives particulars of interest concerning the geology and gold discoveries in that district.

The concluding articles of Part 1, entitled "Glacial Phenomena of Toronto and Vicinity" and "Moraines North of Toronto" by Dr. A. P. Coleman and Mr. Frank B. Taylor respectively, deal with the interesting glacial developments at and near the City of Toronto. These papers were prepared originally in connection with the meeting of the International Geological Congress in Toronto, August, 1913.

Part II deals with the Pre-Cambrian geology of Southeastern Ontario, the authors being Professor Willet G. Miller, Provincial Geologist, and Mr. Cyril W. Knight, Assistant Provincial Geologist. The age and structural relations of the rocks are described, and an account is given of the mineral industries of the region. For many years the geology of this part of the Province has attracted the attention of field men, but many difficulties have been met with, and the relations of the rocks have not been clearly understood. From time to time, as opportunity offered during the last few years, Messrs. Miller and Knight have made a detailed study of areas at several points along a strip of country sixty-five miles in length from Peterborough in the west, to Frontenac county on the east. It is believed that this work will be not only of scientific interest, but will have an important economic bearing. It has already resulted in the opening of a large quarry near Havelock which furnishes trap rock, the best material for road-making purposes, and it is expected that other quarries will soon be opened. The district is an important one, from the very considerable variety of economic minerals which it contains.

I have the honour to be, Sir,

Your obedient servant,

THOS. W. GIBSON,
Deputy Minister of Mines.

BUREAU OF MINES,
DEPARTMENT OF LANDS, FORESTS AND MINES.
Toronto, 16th April, 1913.

REPORT OF THE BUREAU OF MINES 1913

VOL. XXII. PART I.

STATISTICAL REVIEW

By Thos. W. Gibson, Deputy Minister of Mines

The mining industry of Ontario continues to expand, not only in the quantity and value of the annual production, but also in the area embraced within its operations.

The beginnings of the industry were on the shore of lake Erie, where a hundred years ago the settlers smelted the bog iron ores of the locality into stoves and potash kettles. In the eastern part of the Province the rocky areas proved to contain iron, gold, mica, and many other useful metallic and non-metallic minerals on which have been established industries of local, and in some cases more than local, importance. The shores of the great lakes, being accessible by water, lay open to the early prospectors, who were rewarded by the finding of copper at Bruce Mines, and silver at Silver Islet and on the mainland of lake Superior.

The period of railway building set in, and wherever a pathway was opened in the forest, it became a base, sometimes indeed the actual site, of fresh discoveries. In a cut of the Canadian Pacific railway, near Sudbury, in the year 1883, the first copper ores of that region were found, which soon proved to contain nickel, and so led to the opening up of the world's chief source of supply of that metal. The building of the C. P. R. enabled prospectors to ply their calling on Lake of the Woods and to penetrate to the valley of the Seine river, where they found gold indeed, but failed to open up a permanent gold field. The rumours of placer gold drew a crowd of prospectors into the wilds of Michipicoten in 1897. They found no golden sands, but in 1898 there was discovered the Helen mine, which brought about the building of the Algoma Central railway. A stretch of fertile land at the head of lake Temiskaming had called for years for connection with older Ontario, but not even the standing promise of a substantial bonus by the Government induced private capital to undertake the construction of a railway. The Government itself set about the task, and Cobalt was discovered, one of the richest silver camps ever made known. Gowganda, South Lorrain and Casey followed, and in 1909 Porcupine, now getting into its stride as a producer of gold.

The only key to the future is found in the past, and in the vast area of pre-Cambrian rocks yet unprospected in northern Ontario—to which was added last year the principality of Patricia—it can hardly be doubted that many more deposits of mineral wealth will be found, some of them perhaps as rich as any that have yet been brought to light.

For the year 1912 the returns made by mining companies and mine owners show the aggregate production of minerals and mineral products to have had a value at the point and in the form produced of $48,341,612. In 1911 the value was $41,976,797, so that the increase for the year was $6,364,815 or 14.9 per cent.

The following Table (No. I) gives particulars of production, as well as the number of employees and wages paid for labour.

Table I.—Mineral Production of Ontario, 1912

Product.	Quantity.	Value.	Employees.	Wages.
Metallic:		$		$
Gold ....ounces	(a) 102,278	2,114,086	1,183	1,254,361
Silver .... ''	(b) 30,719,883	17,671,918	3,746	3,543,419
Cobalt ....tons	936	315,781		
Copper....................... ''	11,126	1,584,310	2,881	2,404.889
Nickel .... ''	22,850	4,736.460		
Platinum....................ounces	(c) 2,366	80,736		
Palladium .... ''	(d) 4,316	147,235		
Iron ore ....tons	117,357	238,884	687	550.744
Pig iron .... ''	589,593	8,054,369	846	636,420
Lead (concentrates)........... ''	26	1,290	19	3,074
	....	34,945.069	9,362	8.392.907
Less Ontario iron ore smelted into pig iron (71,589 tons)	....	145,326	....	....
Net metallic production..........	....	34,799.743	....	....
Non-metallic:				
Arsenic.......................tons	4,166	79,297	(e)	(e)
Brick, common.................. No.	385,000,000	3,178,250	2,582	1,012,469
Tile, drain.................... ''	16,463,000	279,579		
Brick, paving, etc. .... ''	8,082,000	221,986	732	386,627
Brick, pressed .... ''	65,598,000	634,169		
Building and crushed stone	....	953,839	829	371 041
Calcium carbide...............tons	1,998	120,000	44	27,697
Cement, Portland .... bbl.	2,993,367	3,365,659	1,551	876,722
Corundum ....tons	1,960	233,212	197	123.465
Feldspar .... ''	13,633	28,916	60	21,257
Graphite .... ''	1.246	65,076	84	24,201
Gypsum .... ''	31,331	50,246	140	59,823
Iron pyrites .... ''	20,744	71,043	170	115.342
Lime ....bush.	2,297,525	281,672	379	113,344
Mica ....tons	570	57,384	79	35,116
Natural gas.......... million cub. ft.	12,414	2,268,022	277	184,351
Peat ....tons	175	725	15	520
Petroleum.................Imp. gal.	8,432,730	344.537	(f) 699	(f) 436.852
Pottery	....	52,445	34	17,630
Quartz ....tons	94,758	179,576	112	68.506
Salt.......................... ''	90,986	450,251	219	151.218
Sewer pipe	....	464,627	230	140.398
Talc ....tons	6,726	61,358	79	32,396
Non-metallic production	....	13,541,869	8,512	4,198.975
Add metallic production	....	34,799,743	9.362	8,392.907
Total production	....	48,341,612	17,874	12,591,882

(a) See under "Gold," p. 10. (b) See under "Silver," p. 12. (c) See under "Platinum," p. 26. (d) See under "Palladium," p. 26. (e) Included under "Silver" and "Cobalt." (f) In refining works only.

The increase in production as compared with 1911 was largely in the metals, the value of which was greater by $5,696,876, or 19.5 per cent. Non-metallic substances advanced in value by $667,939, or 5.1 per cent. Of the entire output, the metalliferous list provided 72 per cent., and the non-metalliferous 28 per cent., as against 70 per cent. and 30 per cent. respectively in 1911.

From Table II, given below, it will be seen that among the metals decided gains were made in gold ($2,071,449), silver ($1,718,023, or 10 per cent.), nickel ($1,071,986, or 29.2 per cent.), copper ($303,192, or 23.6 per cent.), and cobalt ($144,891, or 84.7 per cent.). The gold production given for 1912 includes, as is more fully explained under the heading of "Gold," a considerable output really belonging to the six years beginning with 1907, of which no report has been made until now. The item for cobalt also obtains some advantage from the fact that much of the mixed oxides of cobalt and nickel which are produced in the process of refining the ores from Cobalt are shipped without being separated from each other. Cobalt predominating, both in quantity and value, the whole is credited to cobalt alone. There was a moderate advance in pig iron ($338,055, or 4.3 per cent.). The single decrease was in iron ore ($207,046, or 46.1 per cent.).

In the non-metallic substances, the chief increases were in common brick ($376,279, or 13.5 per cent), paving and fancy brick ($135,301, or 156 per cent.), pressed brick ($69,539, or 12.1 per cent.), stone ($61.212, or 6.8 per cent.), corundum ($86,054, or 5.8 per cent.), quartz $115,171, or 17.8 per cent.) and sewer pipe ($54,563, or 13.3 per cent.). The largest decreases were in Portland cement ($274,983, or 7.5 per cent.), feldspar ($22,694, or 43.9 per cent.), iron pyrites ($47,414, or 40 per cent.). and drain tile ($69,966, or 20 per cent.).

Table II.——Comparative Value Mineral Production, 1911 and 1912

Product.	1911	1912	(I) Increase. (D) Decrease.	
Metallic:	$	$		$
Gold	42,637	2.114.086	I	2,071.449
Silver	15,953,895	17,671.918	I	1.718.023
Copper	1,281,118	1.584.310	I	303.192
Nickel	3,664.474	4.736.460	I	1.171,986
Iron ore	445,930	238,884	D	207,046
Pig iron	7.716,314	8,054.369	I	1.338.055
Cobalt	170,890	315.781	I	144.891
Non-metallic:				
Arsenic	74,609	79.297	I	4.688
Brick, common	2,801,971	3.178.250	I	376,279
" paving, fancy, etc	86,685	221.986	I	135,301
" pressed	564,630	634,169	I	69.539
Building and crushed stone	892.627	953.839	I	61,212
Calcium carbide	84,437	120.000	I	35.563
Cement, Portland	3,640,642	3,365.659	D	274.983
Corundum	147,158	233.212	I	86.054
Feldspar	51,610	28.916	D	22,694
Fluorspar	200	....	D	200
Graphite	36,492	65.076	I	28,584
Gypsum	32,535	50.246	I	17.711
Iron pyrites	118.457	71.043	D	47,414
Lime	402,340	381,672	D	20,668
Mica	43,058	57,384	I	14.326
Natural gas	2,186.762	2.268,022	I	81.260
Peat	2.830	725	D	2.105
Petroleum	353.573	344.537	D	9,036
Phosphate of lime	240	....	D	240
Pottery	50,500	52,445	I	1,945
Quartz	64.405	179.576	I	115,171
Salt	430,835	450.251	I	19,416
Sewer pipe	410,064	464.627	I	54,563
Talc	47.725	61.358	I	13.633
Tile, drain	349.545	279.579	D	69.966

An Accelerating Production

During the five years covered by Table III, beginning with 1908, the products of the mines, quarries and mineral works of the Province have increased in value by 88 per cent. It is in the metalliferous materials that the more notable increase have taken place. The entire list of products of this kind participates in the increase save one—iron ore, the output of which has of late shown a tendency to diminish. Gold remained stationary at a small production until 1912, when the effect of the opening up of the Porcupine deposits began to be seen. Silver, notwithstanding a reduction in the quantity produced, brought a greater return in 1912 than in any previous year, because of the higher prices which prevailed. Nickel expands steadily, and carries along with it its by-product, copper. Cobalt is also a by-product, the figures for which are assuming more importance as the business of refining and especially of marketting it is being mastered. Among the rarer metals platinum and palladium reappear in 1912, after an absence of some years. The statistics given are not, strictly speaking, for that year only, but represent an unreported output for the six years beginning with 1907.

The changes in the production of the non-metallic materials have not been so marked. There has been a steady growth in the output and value of brick of all varieties, also of stone both for building purposes and crushed for road material and use as a flux. Portland cement shows a rapid growth until 1912, when for the first time since the manufacture began in 1891, there was a check in the output, the figures falling below those for 1911. Lime alone among the materials of construction seems to be losing ground, possibly because of partial displacement by cement. The decline in the yield of petroleum, remarked on in this Report annually for a number of years, shows no symptom of abatement. Natural gas continues to advance, but the increase in 1912 over 1911 is comparatively small. Salt maintains an annual production of less than half a million dollars in value, and shows little fluctuation from one year to another. Sewer pipe made in Ontario appears to be coming into better demand, for the production has been for some years rising in value; but another clay product, drain tile, shows an unusual falling off in 1912. Pottery, too, remains stationary. Notwithstanding private and governmental effort, the manufacture of peat fuel makes little headway, measured at any rate by quantity of actual output. The milling of talc is becoming more important yearly; mica barely holds its own against competition from India; the feldspar quarries on the Kingston and Pembroke railway were active during the latter part of the five-year period, but less so in 1912, and iron pyrites also failed to maintain in that year the advances successively made for several years before. Graphite and gypsum have both increased, the latter markedly so; this is true also of corundum, though the destruction by fire of the only operating plant for treating this mineral may cause a temporary stoppage of production. Quartz for flux and converter linings is being raised in larger quantities; white arsenic, made from the ores of Cobalt, has of late found a good market; carbide of calcium, though higher in 1912 than in 1911, did not attain to the level of the earlier part of the five-year term. The production of apatite, or phosphate of lime, has practically ceased, and fluorspar, though appearing in the Tables for 1910 and 1911, has not yet been produced in quantity. Further comment on the progress of the various departments of mining will be found under the heading of the several products.

Table III.—Mineral Production, 1908 to 1912

Product.	1908	1909	1910	1911	1912
Metallic:	$	$	$	$	$
Gold	60,337	32,445	68,498	42,637	2,114,086
Silver	9,136,830	12,464,722	15.481,322	15,953,895	17,671,918
Cobalt	111,118	94,965	54,699	170,890	315,781
Copper	1,071,140	1,127,015	1,374,103	1,281,118	1,584,310
Nickel	1,866,059	2,790,798	4,005,961	3,664,474	4,736,460
Iron ore	574,839	645,622	513,721	445,930	238,884
Pig iron	4,390,839	6,301,528	6,975,418	7,716,314	8,054,369
Zinc ore	....	8,950	5,760	....	....
Lead	....	....	....	....	1,290
Platinum	....	....	....	....	80,736
Palladium	....	....	....	....	147,235
	17,211,162	23,466,045	28,479,482	29,275,258	34,945,069
Less value Ontario iron ore smelted into pig iron	456,176	537,549	317,804	172,391	145,326
Net metallic production	16,754,986	22,928,496	28,161,678	29,102,867	34,799,743
Non-metallic:					
Actinolite	....	....	320	....	....
Arsenic	40,373	61,039	70,709	74,609	79,297
Brick, common	1,575,875	1,916,147	2,374,287	2,801,971	3,178,250
" paving	61,554	73,700	70,648	86,685	221,986
" pressed	485,819	490,571	458,596	564,630	634,169
Building and crushed stone	530,041	660,000	761,126	892,627	953,839
Carbide of calcium	147,150	151,676	184,323	84,437	120,000
Cement, Portland	2,417,769	2,897,348	3,144,343	3,640,642	3,365,659
Corundum	11,437	140,817	171,994	147,158	233,212
Feldspar	20,300	36,204	47,518	51,610	28,916
Fluorspar	....	....	15	200	....
Graphite	1,600	37,624	55,637	36,492	65,076
Gypsum	20,778	23,604	17,825	32,535	50,246
Iron pyrites	69,980	78,170	98,353	118,457	71,043
Lime	448,596	470,858	474,531	402,340	381,672
Mica	73,586	73,124	85,294	43,058	57,384
Natural gas	988,616	1,188,179	1,491,239	2,186,762	2,268,022
Peat fuel	900	240	1,284	2,830	725
Petroleum (crude)	703,773	559,478	368,153	353,573	344,537
Phosphate of lime	7,048	1,904	....	240	....
Pottery	50,310	43,214	51,485	50,500	52,445
Quartz	52,830	75,329	87,424	64,405	179,576
Salt	488,330	389,573	414,978	430,835	450,251
Sewer pipe	344,260	311,830	357,087	410,064	464,627
Talc	3,048	8,700	46,592	47,725	61,358
Tile, drain	338,658	363,550	318,456	349,545	279,579
Total non-metallic production	8,882,631	10,052,879	11,152,217	12,873,930	13,541,869
Add metallic production	16,754,986	22,928,496	28,161,678	29,102,867	34,799,743
Total production	25,637,617	32,981,375	39,313,895	41,976,797	48,341,612

In the Nineteenth Report of the Bureau, page 9, the total production of metals in Ontario was given from the beginning of production to the end of 1909. This table was continued in the Twentieth and Twenty-first Reports, and is here reproduced, so far as values are concerned, with the addition of the figures for 1912. The basis of computing values followed is the one adopted throughout by the Bureau, namely, the selling price in the form and at the point produced.

Table IV.—Total Production of Metals in Ontario

Product.	Value.
	$
Gold	4,734,713
Silver	97,176,289
Platinum and Palladium	290,755
Cobalt	1,072,141
Nickel	41,012,763
Copper	17,239,531
Iron ore	6,724,385
Pig iron	57,246,101
Lead	117,290
Zinc ore	92,410

The footing of the valuation column in the above table is $225,706,378. The only item in which there is any duplication or overlapping is iron ore, a considerable proportion of which was smelted into pig iron, and so included in the latter. Making ample deduction for this, it would appear that up to the end of 1912, the selling value at the mine or works of the metals and metalliferous substances produced in this Province was $220,000,000 at least. If the nickel and copper were valued at the prices of the refined metals in New York, according to the method employed by the Mines Department at Ottawa, the total would be about $290,000,000.

Gold

For the first time in the history of Ontario, there was in 1912 a substantial production of gold. The largest previous yield was in 1899, when a number of stamp mills were operating in the Lake of the Woods and Seine river districts. The output that year amounted to $423,978, but the performance of these fields not proving equal to their promise, the production fell off in 1900 to $297,861. Last year the actual yield of gold within the limits of the Province was 86,603 ounces, worth $1,790,087, or over four times as much as in 1899. To this is added 15,675 ounces, valued at $323,999, recovered at the Orford works of the International Nickel Company, New Jersey, in refining the nickel-copper mattes from the Canadian Copper Company's mines in the Sudbury district. This extraction extended over the six years from 1907 to 1912, but no part of it has hitherto been included in the Bureau's statistics, since no returns of it were made. Though the effect is to swell the figures for the twelve months beyond their strict limits, it seems proper to incorporate this production in the official record at the first opportunity. The total number of ounces stands therefore at 102,278, with a value of $2,114,086.

The feature of the year was the coming into production of the Porcupine camp. The Dome and Hollinger mines both suffered the destruction of their milling plants, then well on their way to completion, by the unprecedented fires of 1911, which were also accompanied by so lamentable a loss of human life. It was not until April and June, respectively, 1912, that the new mills at the Dome and Hollinger were ready to begin work, so that the output for last year by no means represents a full twelve months' operations.

The Hollinger Mine

At the Hollinger mine, the plant went into commission July 1st, with the full complement of thirty stamps, and during the remainder of the year it treated 45,195 tons of ore and rock, from which a recovery was made of $933,682, or an average of $20.33 per ton. Of this, $927,135 was in gold, and $6,547 in silver. The mill and process have proven satisfactory, but after a short time experience led to the abandonment of amalgamation in favor of cyanidation of the concentrates. This necessitated no change in the apparatus, the substitution of cyanide of potassium for mercury in the grinding pans being all that was required. At the end of the year, the underground workings amounted to 8,918 feet, distributed as follows:—5,039 feet of drifts, 2,764 feet of crosscuts, 451 of winzes, 232 of raises, and 432 of shafts. There are levels at 100, 200 and 300 feet. The reserves of ore are placed at $10,230,000, of which $7,560,000 is credited to No. 1 vein, and $1.200,000 to No. 2. In computing the reserves, no allowance is made for ore which may exist beyond a depth of 50 feet below the deepest working of any vein. The total operating profits up to 31 December, 1912, were $600,664, and a monthly distribution of dividends at the rate of 3 per cent. per month was begun in November. Three such dividends of $90,000 each were declared before the close of the year.

Operations here and at the Dome and other mines of the Porcupine camp were much interfered with by a strike of the miners, which began early in November, the men refusing to accept a reduction of wages. The strike was unsuccessful, for the companies were able to procure labour enough to operate the mines and mills, though for a time only partially so, and not a little of the help obtained was of an indifferent character.

The Dome mine also operates thirty stamps, and crushed a large tonnage of ore from the date at which work began. The workings of the Dome Company are open cut, and both the quartz and the schist in which it occurs are put through the mill The other mines which turned out bullion at Porcupine in 1912 were the Vipond and McIntyre. In eastern Ontario, the Cordova; in Lake of the Woods, the Olympia; and in Sturgeon lake, the Northern Gold Reef, Limited (St. Anthony) contributed to the output. Of the total production of $2,014,126, Porcupine supplied $1,730,628, and the remainder of the Province, $452,656, including the gold obtained in refining the Canadian Copper Company's mattes during the last six years, as above set forth.

Other mines at Porcupine, such as Jupiter, McEnaney, Pearl Lake, etc., may be expected to become producers ere long, and it is now evident that this camp is destined to make a substantial contribution to the gold output of Canada, and to break the long record of disappointment which so far has been the chief result of gold discoveries in Ontario.

There are other districts where development has been going on with more or less activity for some time, including Larder lake, Swastika, Munro township, Long lake, etc., but none of them have yet reached the stage of permanent production.

A find of more than ordinary interest has been made at Kirkland lake in the township of Teck. On the Tough-Oakes claims, some very rich ore occurs in small stringers. Since the beginning of 1913, several carloads of ore have been taken out by open-cut methods and shipped in bags, the ore realizing $448 per ton. The property is being opened up by Mr. C. A. Foster, of Haileybury, discoverer and first owner of the Foster silver mine at Cobalt.

A New Find in Michipicoten

Towards the close of last season, a discovery of gold was made in township 34, Range 24, Michipicoten. During the fall and winter a number of mining claims were staked out, but no work has yet been done to test their value. The locality of the discovery is about 55 miles southward of White River station on the Canadian Pacific railway, and about 10 miles north of lake Superior. A good canoe route, with only two difficult portages, leads up White river, across Pokay lake, down the Dog river, and over a number of small lakes into lake Michi Biju. The more promising of the two main outcrops is a 3-foot silicified zone cutting a well-mineralized green schist, and ramified by numerous small stringers of quartz. At the discovery post the hanging wall of the zone is exposed to a height of 12 feet above the adjoining small valley. On the wall, the gold occurs in small blebs and scales and again is heavily intermixed with arsenical pyrites, which occurs in patches. A sample of the pyrites was assayed by the Provincial Assayer and showed a high gold content. This sample was taken from the wall only, and covered but 15 feet of the best material then showing, consequently the result cannot be considered as that of a fair average sample. It is as yet uncertain whether or not the gold-bearing arsenical pyrites is confined to the hanging wall or, what seems more likely, whether it is associated with the numerous small enclosed quartz stringers that follow the trend of the zone.

The other gold-bearing formation occurs a mile farther north. Here, on the edge of a small lake, a quartz vein having a width of at least 20 feet at the discovery post, outcrops prominently for a distance of 200 feet. The only sample taken, from the hanging wall, showed a gold content of $1.20. The quartz looks promising, and it is possible that systematic sampling may prove the vein to be worthy of exploitation.

Owing to the closeness of the freeze-up, nothing in the way of sampling or actual testing of either of the two main outcrops could be undertaken. It is intended to prospect the formations during the coming season. The geological conditions are in general favorable, and resemble those obtaining in other Ontario goldfields. The thick forest growth and the heavy over-burden, however, combine to make prospecting in this but little explored part of the Province difficult, tedious and expensive.

Gold Mining Companies

Following is a list of the gold mining companies in operation during 1912, distinguishing between those which produced bullion and those which did not:—

Name of Company.	Name of Mine	Locality.	P. O. Address of Manager, etc.
Producing Companies:—			
The Dome Mines Company, Limited	Dome	Porcupine	South Porcupine.
Hollinger Gold Mines, Limited	Hollinger	Porcupine	Timmins.
Vipond Porcupine Mines Company, Limited	Vipond	Porcupine	Schumacher.
McIntyre Porcupine Mines, Limited	McIntyre	Porcupine	Schumacher.
Northern Gold Reef, Limited	St. Anthony	Sturgeon Lake	Toronto.
Cordova Mines, Limited	Cordova	Peterboro' county	Cordova Mines.
Olympia Gold Mining Company, Limited	Olympia	Shoal Lake	92 Reaney Street, St. Paul, Minn.
Non-producing Companies:—			
Ore Chimney Mining Company, Limited	Ore Chimney	Frontenac county	335 Brisbane Bldg., Buffalo, N.Y.
Crown Reserve Mining Company, Limited	McEnaney	Porcupine	Cobalt.
Canadian Exploration Company, Limited	Long Lake	Long Lake	Naughton.
Lucky Cross Mines of Swastika, Limited	Lucky Cross	Swastika	Swastika.
The Swastika Mining Company, Limited	Swastika	Swastika	18 Toronto Street, Toronto.
The Gilmour Mining Company, Limited	Gilmour	Hastings county	Gilmour.
Jupiter Mines, Limited	Jupiter	Porcupine	Schumacher.
Dome Lake Mining and Milling Company, Limited	Dome Lake	Porcupine	Schumacher.
Pearl Lake Gold Mines, Limited	Pearl Lake	Porcupine	Schumacher.
Plenaurum Mines, Limited	Plenaurum	Porcupine	Schumacher.
Goldfields, Limited	Goldfields	Larder Lake	Larder Lake.

Among the non-producing companies, stamp mills were in course of erection about the beginning of 1913 by Crown Reserve, Lucky Cross Swastika, Dome Lake. Canadian Exploration Company and Goldfields, Limited, are already equipped, having made extensive alterations during the year, including the installation of hydraulically generated electric power. The former derives current from the Wahnapitae river, and the latter from the falls at Raven lake.

Silver

The production of silver last year amounted to 30,719,883 ounces, which was 787,997 ounces less than in 1911. Owing to the higher price of silver, however, the value was greater by $1,718,023, or $17,671,918 in all. Cobalt, of course, was the preponderant source of supply, others being the gold obtained from Porcupine and elsewhere, and the nickel-copper mattes of Sudbury. These sources contributed respectively as follows:

	Ounces.	
Cobalt proper	28,859,764	
Gowganda	549,976	
South Lorrain	834,119	
		30,243,859
Gold ores		16,776
Canadian Copper Company's mattes		459,248
Total		30,719,883

The explanation of the last item is similar to that already given regarding the gold obtained from the same material; the quantity mentioned was recovered at the Orford works of the International Nickel Company in New Jersey during the last six years. It has not been included in any of the statistics previously published by the Bureau of Mines for the reason that it was omitted in the returns for the years in question.

From the year 1904 when the first silver was obtained from the mines of Cobalt, the production of the camp has amounted in all to 155,815,839 ounces, the sum received by the mining companies for which was $81,731,115.

The producing mines numbered 30 as against 34 in 1911, those whose output was a million ounces or more being

	Ounces Shipped.
Nipissing	4,719,578
Coniagas	3,703,942
La Rose	2,920,344
Crown Reserve	2,714,766
McKinley-Darragh-Savage	2,704,868
Kerr Lake	1,895,309
Buffalo	1,890,150
Cobalt Townsite	1,505,396
Temiskaming	1,242,243
Cobalt Lake	1,123,146
O'Brien	1,091,631

The other producing mines were Penn-Canadian, Hargrave, Bailey Cobalt, Hudson Bay, Casey-Cobalt, Colonial, General, City of Cobalt, Trethewey, Right of Way, Chambers-Ferland, Beaver, Cobalt Provincial, Drummond, Seneca-Superior, Miller Lake-O'Brien, Mann, Wettlaufer-Lorrain. New-comers on the producing list are Bailey, Seneca-Superior and Mann. The following yielded more or less silver in 1911, but none in 1912: Silver Cliff, Standard Cobalt, Green-Meehan, Belellen, Nancy-Helen, Wyandoh, King Edward. The name of the Cobalt Central mine is now Penn-Canadian, and Seneca-Superior partially takes the place of Peterson Lake, being situated on part of the bed of that lake, or rather of Cart lake which at the time of making the grant was thought to be an extension of the former, instead of a separate body of water.

The producing mines in Gowganda were Miller Lake-O'Brien, Millerett and Mann, and in South Lorrain, Wettlaufer-Lorrain.

Shipments

Shipments of ore and concentrates from Cobalt can no longer be taken as indicating the tonnage raised from the mines, since the tendency towards absolute refinement of the silver on the spot is becoming more marked year by year. For instance, two of the leading mines, Nipissing and Buffalo, are now equipped for reducing their entire output, both of high grade and low grade ore, to merchantable bars, which leave the camp in an express car. In consequence, the quantity of bullion produced at Cobalt is steadily increasing, being 5,080,127 ounces last year as compared with 3,122,976 ounces in 1911. The shipments by freight were smaller than in the previous year, the ore shipped out amounting to 10,719 tons as against 17,278 tons in 1911, and concentrates to 11,214 tons, as against 9,393. The several classes of material sent out of the camp and their silver contents, respectively, were as follows:—

Product.	Quantity. (tons)	Silver. (ounces)
Ore	10,719	15,395,504
Concentrates	11,214	9,768,228
Bullion	....	5,080,127
Total	21,933	30,243,859

The above figures refer, of course, to the output of the mines of Cobalt and subsidiary fields only, and the difference between the total silver contents of the shipments and the production of the Province given in Table I is due to the inclusion in the latter of the silver extracted from gold ores and nickel-copper mattes.

Ore Concentration

In all, 456,167 tons of ore were put through the concentrating plants, of which 101,338 tons were treated at the several custom concentrators now working in the camp, namely, those of the Nipissing Reduction Company, the Dominion Reduction Company, and the Northern Concentrators, Limited. The remainder, 354,829 tons, were manipulated by the mining companies in their own plants. The average ratio of cocentration works out therefore at 39 tons of ore to one ton of concentrates. The silver contents of the concentrates were 9,768,228 ounces, an average of 871 ounces per ton. The quantity of ore or rock subjected to concentration being 456,167 tons, the recovery was at the rate of 21.4 ounces per ton. Assuming that 85 per cent. of the original silver was contained in the concentrates, the silver contents of the concentrating material as it went into the mill would be 25.1 ounces per ton. These results correspond closely with those obtained in 1911, when the concentrates carried 858 ounces per ton, the silver recovered averaging 21.6 ounces per ton, and the concentrating ore 25.4 ounces per ton.

Four refineries were in operation in Ontario on ore and concentrates from Cobalt last year, namely, those of the Canadian Copper Company, at Copper Cliff, the Coniagas Reduction Company, at Thorold, the Deloro Mining and Reduction Company, at Deloro, and the Canadian Refining and Smelting Company at Orillia. Of these, the one at Copper Cliff worked for part of the year only, and is still idle, while the Orillia works have since been burned down. The total quantity of ore and concentrates treated at these establishments was 8,111 tons, which yielded 15,675,218 ounces of silver. Bullion produced at Cobalt itself amounted to 5,080,127 ounces, so that not less than 67.5 per cent. of the total silver yield of the mines was refined in the Province, as compared with 66 per cent. in 1911.

The Dominion Refineries, Limited, have established a plant at North Bay, for the treatment of Cobalt ores low in silver. A new refinery is being built at Kingston, by the Buffalo and Ontario Smelting and Refining Company, Limited. The Metals Chemical Company, Limited, have also erected a plant for the production of cobalt and nickel oxides at Welland.

A summary of the operations of the silver refineries of Ontario for 1911 and 1912, so far as silver is concerned, is as follows, the by-products being dealt with under their respective headings:—

	1911.	1912.
Silver refineries in operation	4	4
Silver-cobalt ore received, tons	9,142	8,274
Silver-cobalt ore treated, tons	9,330	8,096
Silver recovered, fine ounces	17,756,651	15,675,218
Value of ditto	$9,248,829	$9,094,156

Markets and Prices

There was a good demand for the silver-cobalt ores during the year. The refining companies in Ontario have, through their efforts to keep their plants supplied, no doubt assisted in maintaining the prices of ore, but in view of the diminution in their number, and the fact that one of them, the Coniagas Reduction Company, is now sufficiently occupied with ore from the Coniagas mine, their influence in this direction is likely for the time being to be less than in the past. New Jersey, Pennsylvania and Colorado smelting works took most of the ore that went to the United States, much of it low grade, but being silicious, it is found highly useful for mixing with basic material.

Prices of silver are fixed by influences which find their stage largely in the Orient. The requirements for coinage and the arts in the commercial and manufacturing nations of America and Europe absorb considerable quantities, but production continues at a rate which would inevitably depress the price of silver to lower levels were it not for the capacity which India and China have, almost from time immemorial, shown to buy a large share of the world's output. Thus in 1912 the production of silver is estimated to have been 229,569,903 fine ounces,* worth at the average price for the year in New York, say, $139,658,850. The imports of India during the year amounted in value to $59,975,802, and of China, to $20,971,423, or together to $80,947,225, a good deal more than one-half the entire output for the year. The explanation of the movement of silver to these countries is two-fold—the medium of exchange is silver, and in India the habit of generations has been, and still is, to use silver in the form of bars, personal ornaments, objects of art, etc., as a means of hoarding the savings of the people. The preliminary market is London, whose control of trade with the East remains unshaken, and to which all the silver mines of the world send their bars of silver, whose size, dimensions and weight are determined by the preferences of the silversmiths of the Indian bazaars. The intercourse between the Pacific coast of the United States and China has led, of late years, to the export of a certain amount of silver to that country from San Francisco. This export last year was in value $11,503,620, as against $9,234,000 in 1911.

The actual price throughout the year was much higher than in 1911, the average for fine silver in New York being 60.835 cents per ounce, as against 53.304 cents in 1911. The market steadily advanced from the beginning of the year, and recessions were few and slight. The year closed with silver at 63.365 cents as the average for December. The settlement of the new Republican Government in control of China, and the anticipated reforms in the currency system of that country with their accompaniment of large loans and heavy purchases of silver, the requirements of the Indian Government for coinage purposes which were met by the purchase of £6,000,000 worth of silver in London, and favorable monsoon rains in India, all tended to raise prices, which even the outbreak of the Balkan war in October did not materially check.

The increase in the price of silver over 1911, say 7.531 cents per ounce, applied to the production for the year, meant $2,313,514 additional return to the mining companies of Cobalt.

It may be remarked in connection with the causes which affect the prices of silver that the preference for silver for hoarding purposes which has for so long a time characterized the people of India, seems now to be yielding to a liking for gold. Gold bars, to the value of $39,482,640, were imported into India during 1912, as against $37,699,020 in 1911. How much of this went into the banks for coinage reserve purposes, and how much into the pockets of the people, there are no certain means of determining, but it seems probable that a larger proportion of the savings of the peasants of India are now being invested in gold than formerly, and that the incidence of this tendency will have some effect upon silver prices in the future.

Table No. V. which follows shows the total output of silver from the mines of Cobalt since they were opened in 1904:—

Table V.—Silver Production, Cobalt Mines, 1904 to 1912

Year.	Producing Mines.	Shipments.			Silver Contents.			Av'ge Silver Contents per Ton.		Value of Silver Shipments.			Total Value.
		Ore,	Concentrates	Bullion,	Ore.	Concentrates,	Bullion,	Ore.	Concentrates,	Ore.	Concentrates.	Bullion.	
	No.	Tons.	Tons.	oz.	oz.	oz.	oz.	oz.	oz.	$	$	$	$
1904	4	158	.....	....	206,875	....	....	1,309	....	111,887	....	....	111,887
1905	16	2,144	.....	....	2,451,356	....	....	1,143	....	1,360,503	....	....	1,360,503
1906	17	5,335	.....	....	5,401,766	....	....	1,013	....	3,667,551	....	....	3,667,551
1907	28	14,788	.....	....	10,023,311	....	....	677	....	6,155,391	....	....	6,155,391
1908	30	24,487	1.137	....	18,022 480	1,415,395	....	736	1,244	8,468,293	665,085	....	9,133,378
1909	31	27,729	2,948	....	22,436,355	3,461,470	....	809	1,174	10,809,872	1,651,704	....	12,461,576
1910	41	27,437	6,845	980,633	22,581,714	7,082,834	980,633	821	1,030	11,360,489	3,590,098	527,460	15,478,047
1911	34	17,278	9,375	3,132,976	20,318,626	8,056,189	3,132,976	1,176	858	10,250,991	4,017,241	1,685,615	15,953,847
1912	30	10,719	11,214	5,080,127	15,395,504	9,768,228	5,080,127	1,436	871	8,766,871	5,556,919	3,085,145	17,408,935
Tl..	..	130,075	31,519	9,193,736	116,837,987	29,784,116	9,193,736	898	945	60,951,848	15,481,047	5,298,220	81,731,115

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* Eng. and Mg. Jour., New York, 11th January, 1913.

The Subsidiary Constituents

The other constituents of the Cobalt silver ores made use of industrially are cobalt, nickel and arsenic. For some time past these elements have not been of interest to the mine owners, since they add nothing to the value of their ore, and for this reason it is impossible to procure exact figures showing the quantities produced. The ores are not assayed for nickel or cobalt or arsenic, and it is undoubtedly the case that only a percentage of these substances ever reaches the market in the finished form or in a condition to be made use of industrially. All three constituents are recovered by the Canadian refiners, who treat the ores from Cobalt without admixture of other kinds of ore, and who produce white arsenic, cobalt oxide, nickel oxide, and also a mixture of the oxides of cobalt and nickel which they ship without final separation principally to English and European manufacturers of cobalt oxide. In the case of refineries situated in the United States, the ores from Cobalt are mixed in the smelting charge with ores of lead and copper, etc.; and little or no attempt is made to save the arsenic, nickel or cobalt. Table VI, which is subjoined, gives the total production of silver, nickel, cobalt, and arsenic from the mines of Cobalt from the beginning. The assumption is made that the ores and concentrates as shipped contain 1.47 per cent. nickel, 3.20 per cent. cobalt and 14.28 per cent. arsenic, but the values attached to the several substances are those which have been obtained by the refiners on the sale of the products as marketed.

Table VI.—Total Production, Cobalt Mines, 1904 to 1912

Year.	Nickel.		Cobalt.		Arsenic.		Silver.		Total Value.
	Tons.	Value.	Tons.	Value.	Tons.	Value.	Ounces.	Value.	
		$		$		$		$	$
1904....	14	3,467	16	19,960	72	903	206,875	111,887	136,217
1905....	75	10,000	118	100,000	549	2,693	2,451,356	1,360,503	1,473,196
1906....	160	....	321	80,704	1,440	15,858	5,401,766	3,667,551	3,764,113
1907....	370	1,174	739	104,426	2,958	40,104	10,023,311	6,155,391	6,301,095
1908....	612	....	1,224	111,118	3,672	40,373	19,437,875	9,133,378	9,284,869
1909....	766	....	1,533	94,965	4,294	61,039	25,897,825	12,461,576	12,617,580
1910....	504	....	1,098	54,699	4,897	70,709	30,645,181	15,478,047	15,603,455
1911....	392	....	852	170,890	3,806	74,609	31,507,791	15,953,847	16,199,346
1912....	429	14,220	934	314,381	4,166	80,546	30,243,859	17,408,935	17,818,082
Total.	3,322	28,861	6,835	1,051,143	25,854	386,834	155,815,839	81,731,115	83,197,953

Health and Labour

So far as epidemic diseases are concerned, health conditions were satisfactory during the year at Cobalt. There was an almost complete absence of typhoid, which indeed has not been prevalent in the district since 1909.

As regards labour, the relations between employers and employed have on the whole been tolerably good. The Cobalt miners took no action when their fellow-workmen at Porcupine went out in November, but the question of an eight-hour working day has been the subject of considerable discussion. In several of the leading mines nine hours from bank to bank had for some time constituted a day's labour, and in February, 1913, the mining companies voluntarily made this general.

It will be remembered that a measure to restrict the working hours to eight in every twenty-four for underground employees was introduced into the Legislature by the Government in the session of 1912, but was subsequently withdrawn in order to admit of a fuller investigation of all the conditions not only at Cobalt, but in the other mining districts of the Province. Mr. S. Price, late Mining Commissioner, was appointed to make the investigation, and he reported in favor of an eight-hour day from face to face. An Act was passed in the session of 1913 limiting the hours of underground labour accordingly, and fixing the first day of January, 1914, as the time for the change to take effect.

The wage scale at one of the leading mines at Cobalt is as follows per day of nine hours:—

Surface.—Surface boss $3.75, carpenters $3.25, do. helpers $2.25, mechanics $3.25, pipe-fitters $3.00, head blacksmith $3.75, blacksmiths $3.25, do. helpers $2.75, engineers $3.60, firemen $3.00, head ore-sorter $2.75, ore-sorters or cobbers $2.50, hand-miners $2.75, teamsters $2.50, hoistmen $2.75, cage or bucket-tenders $2.50, other surface labour $2.25.

Underground.—Timbermen $3.25, machinemen $3.25, ditto helpers $2.75, cage or bucket-tenders $2.50, other underground labour $2.50.

The foregoing scale is about 25 cents per day less than the rates paid at Porcupine at the present time. Much of the labour is non-English-speaking and inexperienced. Skilled miners are in good demand.

Profits and Dividends

The high price of silver made the year 1912 a good one for shareholders in the producing companies, and the sum distributed in dividends was large, being $9,324,049.24, or $590,091.08 more than in 1911. The total amount paid out as dividends and bonuses since the inception of the camp up to the end of 1912 was $39,834,740.54, not including the profits made by private owners, which would increase it by nearly five million dollars more.

Table VII, printed on page 18, gives a statement of the dividends paid by the silver-mining companies of Cobalt, and also other particulars, such as the date of incorporation, amount of capital, etc.

Table VII—Dividends and Bonuses Paid and Declared by Silver-Cobalt Mining Companies to December 31st, 1912.

Name of Company.	Date of Incorporation.	Authorized Capital.	Capital Stock issued.	Par value per share.	Amount of Dividends and Bonuses declared to end of 1911.	Amount of Dividends and Bonuses declared during 1912.	Total of Dividends and Bonuses declared to Dec. 31, 1912.	Last Dividend or Bonus.	
								Date declared.	Rate per cent.
		$	$	$	$ c.	$ c.	$ c.		
Beaver Consolidated Mines, Limited	Mar. 5, 1907	2,000,000	2,000,000	1.00	170,000 00	180,000 00	350,000 00	Dec. 21, 1912	3
Buffalo Mines, Limited	April 27, 1906	1,000,000	1,000,000	1.00	1,377,000 00	500,000 00	1,877,000 00	Dec. 4, 1912	26
City of Cobalt Mining Company, Limited	Oct. 5, 1906 Jan. 7, 1909	500,000 1,500,000	1,500,000	1.00	139,312 42	....	139,312 42	April 15, 1909	3
Cobalt Central Mines Company	Dec. 13, 1906	5,000,000	5,000,000	1.00	192,845 00	....	192,845 00	Aug. 25, 1909	1
Cobalt Lake Mining Company, Limited	Dec. 22, 1906	(a)4,070,834	3,929,166	1.00	....	75,000 00	75,000 00	Nov. 26, 1912	2½
Cobalt Silver Queen, Limited	April 1, 1906	1,500,000	1,500,000	1.00	315,000 00	....	315,000 00	Dec. 31, 1908	3
Cobalt Townsite Mining Co., Limited	May 6, 1906	100,000	45,011	1.00	125,000 00	346,000 00	471,000 00	Nov. 1912	32¼
Coniagas Mines, Limited	Nov. 21, 1906	4,000,000	4,000,000	5.00	2,840,000 00	1,440,000 00	4,280,000 00	Oct. 11, 1912	9
Crown Reserve Mining Company, Limited	Jan. 16, 1907	2,000,000	1,999,957	1.00	3,714,509 40	1,061,288 40	4,775,797 80	Dec. 15, 1912	5
Foster Cobalt Mining Company, Limited	Feb. 14, 1906	1,000,000	915,588	1.00	45,000 00	....	45,000 00	Jan. 1, 1907	5
Kerr Lake Mining Company, Limited	Aug. 9, 1905	(b) 10,000	10,000	100.00	3,940,000 00	670,000 00	4,610,000 00	Oct. 8, 1912	350
La Rose Mines, Limited	Feb. 21, 1907	(c)6,000,000	6,000,000	5.00	2,672,000 00	1,000,546 84	3,672,546 84	Dec. 16, 1912	6¼
McKinley-Darragh-Savage Mines of Cobalt, Limited	April 9, 1906	2,500,000	2,247,692	1.00	2,156,791 38	1,123,846 00	3,280,637 38	Nov. 4, 1912	20
Nipissing Mining Company, Limited	Dec. 16, 1904	(d) 250,000	250,000	100.00	8,325,797 25	1,842,500 00	10,168,297 25	Dec. 9, 1912	184
Right of Way Mining Company, Limited	July 13, 1906	500,000	500,000	1.00	324,643 93	....	324,643 93	....	....
The Right of Way Mines, Limited	Sept. 11, 1909	2,000,000	1,685,500	1.00	202,260 00	....	202,260 00	Dec. 2, 1911	2
Temiskaming and Hudson Bay Mining Company, Limited	July 29, 1903	25,000	7,761	1.00	1,521,156 00	209,547 00	1,730,703 00	....	300
The Hudson Bay Mines, Limited	July 16, 1909	3,500,000	3,200,050	5.00	394,903 42	192,003 00	586,906 42	Sept. 20, 1912	3
Temiskaming Mining Company, Limited	Nov. 16, 1906 Jan. 1, 1908	2,500,000	2,500,000	1.00	1,009,156 00	300,000 00	1,309,156 00	Dec. 31, 1912	3
Trethewey Silver Cobalt Mine, Limited	May 30, 1906 June 1, 1911	1,000,000 2,000,000	1,000,000	1.00	761,998 50	100,000 00	861,998 50	June 1, 1912	10
Wettlaufer-Lorrain Silver Mines, Limited	Nov. 30, 1908	1,500,000	1,116,590	1.00	283,318 00	283,318 00	566,636 00	Nov. 25, 1912	5
Total	....	....	....	....	30,510,691 30	9,321,049 21	39,831,740 54	....	....

(a) Reduced by shares purchased for cancellation from $5,000,000.
(b) Kerr Lake Mining Company, incorporated under the laws of the State of New York, capital $3,000,000.
(c) La Rose Consolidated Mines Company, incorporated under the laws of the State of Maine, capital $7 500,000.
(d) Nipissing Mines Company, incorporated under the laws of the State of Maine, capital $6,000,000.

For the information of the general public, a summary is given of the printed reports of several of the principal mining companies of Cobalt for the calendar year 1912, or the latest company year, as the case may be. The reports summarized are those of the Nipissing, Coniagas, La Rose, Crown Reserve, McKinley-Darragh-Savage, and Kerr Lake companies.

Nipissing

For the year 1912 there was produced and shipped from the Nipissing mine 4,719,578 ounces of silver, as follows:—

	Dry Tons.	Gross ounces Silver.
High grade ore	121.5635	325,246.92
Low grade ore	1,414.4910	330,990.97
Concentrates	180.6080	153,373.21
Silver Bullion	134.2005	3,909,967.11
Total	1,850.8630	4,719,578.21

The gross value of the silver shipped was $2,892,581.42, and the net value $2,827,299.58. General operation of the mine cost $566,532.82, of which the leading items were: Development and exploration $268,906.08, stoping $83,548.52, insurance and taxes $75,438.39, general and legal expenses $28,110.01, administration and office $24,145.80, boarding-house and camp maintenance $22,974.56. The cost of operating the high grade mill was $99,271.79 and of the low grade mill $30,917.42. Depreciation is estimated at $52,418.14, custom milling cost $41,068.71, marketing product $61,577.03, and corporation, New York office and travelling expenses $13,869.03. Deducing rents and interest $50,374.99, the total expense accounted for $815,279.95, leaving the profits for the year $2,081,710.15. Dividends amounted to $1,842,366.76. The aggregate production of silver from the Nipissing veins to 31st December, 1912, was 27,741,248.32 ounces, and the total sum paid in dividends $10,168,297.25.

The mill for the treatment of the high grade ore ran successfully throughout the year, and treated 1,752 tons of Nipissing ore, averaging 2,212 ounces per ton, also 90 tons of custom ore. The total bullion shipped, including that produced from ore bought, was 4,258,641 ounces. A cyanide plant for treating low grade ore was completed in 1912, and came into full operation after 1st January, 1913; cost $251,839.52. This mill has a capacity of 200 tons per day, and there are 185,000 tons of mill rock, assaying between 20 and 30 ounces per ton, on the dumps and blocked out underground, which alone will keep it going for two and a half years. The management expects the mill to earn enough out of the low grade rock to pay for itself in six months.

Surface prospecting was carried on by the hydraulic plant installed in 1911. During the year 33.2 acres of ground were cleared of soil, the average depth of which was 4.75 feet. The area cleared had been carefully trenched in previous years, but a great many additional small veins and stringers were exposed by the hydraulic operation. The price received for silver averaged 61.457 cents per ounce; the cost of production was 17.39 cents; net profit 44.067 cents. Ore reserves are figured at 9,643,338 ounces. By means of its treatment plants for high grade and low grade ore, the Nipissing Company has been put in a position henceforward to ship practically all its silver as fine bullion.

Coniagas

The Coniagas report is for the year ending 31st October, 1912. It shows that 650 tons of mine ore containing 1,944,213 ounces of silver and 1,287.5 tons of concentrates containing 1,564,164 ounces, or a total shipment of 1,937.5 tons with contents amounting to 3,508,377 ounces silver were forwarded to the Coniagas Reduction works at Thorold. The total quantity of silver paid for or credited to the mining company was 3,309,724 ounces. The total receipts were $2,172,966.54, of which $2,135,621.89 was revenue from ore, $16,679.61 camp revenue, $17,666.38 interest, and $2,954.75 rent. The principal items of working expenses were: Mining $147,682.25, Sale of Ore $155,971.73, Milling $48,300.68, Taxes and Royalties $44,601.49, Camp Expense $17,872.85, Mines Office and Supervision $17,967.64, Head Office and Administration $16,626.32, Employees' Bonus $4,359.61, etc.—a total of $471,412.84—leaving a credit at Loss and Gain of $1,701,553.70. Out of this $1,440,000 was paid in dividends and bonuses, and the balance carried forward to the next year was $1,124,867.11. The total tonnage of ore milled was 53,627, an average of 2.86 tons per stamp for 24 hours. Of the concentrates shipped 803.3 tons were high grade and 484.2 tons low grade slimes. Development of new ore bodies during the year exceeded the shipments by 1,400,000 ounces. Reserves of ore at 31st October, 1912, were estimated at 17,441,800 ounces, of which 13,440,000 ounces were in high grade ore carrying 3,000 ounces per ton. Allowing 20 per cent. for possible over-estimation, the net reserves were placed at 13,953,000 ounces. The total shipments from the opening of the mine were 9,298.1 tons containing 14,090,505 ounces of silver. The Coniagas Mines Limited is capitalized at $4,000,000, and up to the end of 1912 had paid out in dividends a total of $4,280,000. The cost of producing silver, including all charges from mining to marketing, amount to 12.96 cents per ounce.

La Rose

La Rose Consolidated Mines Company is capitalized at $7,500,000. It owns the La Rose, Lawson, Princess and University mines, also La Rose Extension, Violet and Fisher-Eplett prospects. The production is from the three first-named. Ore and concentrates obtained in 1912 carried a total of 2,816,597 ounces of which 2,290,344 ounces were marketed, having a value of $1,644,836 Shipments comprised:

	Tons.	Ounces Silver.
Silver-cobalt-nickel ore	1,653.435	2,161,481.84
Low grade silicious ore	611.054	122,227.62
Nuggets	5.327	125,351.80
Concentrates	1,207.898	511,282.69
Total	3,477.714	2,290,343.95

Net receipts from ore sales were $1,603,969.50, and total cost of production was $730,351.17. Mine operation cost $495,373.71, concentration $102,072.49, marketing ore $165,424.45, depreciation $13,134.04, corporation and travelling expenses $3,830.75. Rents, interest and discounts brought in $49,484.27. Dividends paid during the year amounted to $936,641.86. There was a combined surplus of the holding and operating companies at the end of the year amounting to $1,578,592.11, which, the directors state, is being held for the acquisition of other mining enterprises when proper occasion presents itself. La Rose mine produced more silver than either the Lawson or the Princess, but the difference was smaller than in former years. The ore taken from La Rose came mostly from No. 1 vein, which has been worked out below the first level, the estimated quantity of silver remaining above that level being placed at 435,068 ounces. The great fault which traverses La Rose and the adjoining properties to the south was explored at depth. A strong vein of calcite, in places three feet wide, lies along the fault and was cut at the 380-foot level; it carries some silver throughout, but has as yet developed no high grade ore. The Lawson yielded 732,000 ounces during the year, and the Princess 744,000. Reserves of ore are estimated as follows: La Rose, 1,766,860 ounces, Lawson 148,800, Princess 880,990, total 2,796,650 ounces. The aggregate of dividends paid, including profits to owners previous to 31 May, 1908, is placed at $4,877,409.56 which includes the dividend paid 20 January, 1913.

Crown Reserve

The Crown Reserve Mining Company, Limited, is capitalized at $2,000,000. Its mine is situated on the bed of Kerr lake, where its holdings comprise 23 acres. Silver produced and shipped in 1912 amounted to 2,714,766 ounces, the gross value of which was $1,692,060.76. The mining cost was $311,836.90, consisting of Development $103,482.34, Freight, Treatment and Smelter Deductions $53,869.18, Ore Handling $32,468.43, Power and Light $25,428.10, Depreciation building plant and equipment $23,860.65, Maintenance of building plant and equipment, $19,421.21, General Expenses $20,227.50, Head Office Expenses $19,729.02, Superintendence and Travelling $13,350.47. Milling charges were $68,976.06, making the total cost of ore $380,812.96. The average price received for silver was 62.38 cents per ounce; total cost of silver 14.027 cents per ounce. The profit for the year was $1,311,247.80, out of which was paid in dividends $1 061,288.40, and in royalties to the Government of the Province $147,910.03. Under the terms of purchase from the Crown, the latter is entitled to 10 per cent. of the value of the ore at the pit's mouth. Total shipments from the mine to the end of 1912 were 8,057.4 tons of ore and concentrates, containing 15,227,143 gross ounces of silver, the value of which was $8,273,908.53, and net value $7,773,482.26. The aggregate cost to the same date was $1,687,836.43, the average price per ounce received for silver 54.336 cents, the average cost per ounce 11.084 cents, and the average profit per ounce 43.252 cents. Total dividends paid were $4,775,797.80, and total royalties $727,050.58. No estimate of ore reserves is given, but the intention of the management is stated to be to drain off the waters of Kerr lake, which would make all the ore above the 100-foot level available and open up the remainder of the property for exploration. This company is developing the McEnaney gold mine at Porcupine.

McKinley Darragh Savage

The recovery of silver for the year was 2,717,383 ounces—2,089,593 from the McKinley mine and 627,790 from the Savage—and the shipments 2,704,868 ounces. The average price received per ounce was 61.66 cents, and the total cost 18.59 cents, leaving a profit of 43.07 cents per ounce. Reserves of ore are estimated to contain 5,368,500 ounces, of which 4,133,500 ounces are ascribed to the McKinley, and 1,235,000 ounces to the Savage. The gross tonnage of ore and rock removed from the McKinley mine was 66,332 tons, and from the Savage 32,794 tons, a total of 99,126 tons. There was milled from the McKinley 52,482 tons and from the Savage 17,888 tons, a total of 70,370 tons. Cost of production, including depreciation, amounted to $358,721.13. Sales of silver, less cost of marketing, yielded $1,466,173.52, and there was ore on hand worth $86,596.29; the total value of ore produced therefore was $1,552,769.81. Adding interest $12,095.36, and deducting administration, taxes, insurance and stock and divdend expenses, in all $52,295.14, a net profit was left for the year of $1,153,848.90. Out of this three dividends were paid amounting to $674,307.60, and a further distribution was ordered for 1st January, 1913, of $449,538.40, making a total payment to shareholders on the business of the year of $1,123,846. There have been taken from the property up to 31 December, 1912, an aggregate of 10,770,176 ounces of silver.

Kerr Lake

During the twelve months ending 31 August, 1912, Kerr Lake mine yielded 1,855,495 ounces of silver. Of this 1,741,804 ounces were from shipping ore, and 113,691 ounces from low grade ores milled at the Nova Scotia and Dominion reduction works. Cost of production and development was $224,466.99, shipment, treatment and other charges $38,685.34, administration and general expenses $12,089.34, total $275,241.67. Proceeds of ore sales were $1,034,881.35, and interest $9,536.17, total receipts $1,044,417.52, the balance $769,175.85 being the profit for the year. Dividends amounting to $690,000 were paid, making the total distribution to shareholders $4,020,000. The cost of producing silver was 18.30 cents per ounce. During the previous year it was 14.69 cents, the increase being attributed principally to the greater amount of development work per ton of ore mined, and the larger proportion of lower grade product shipped. The ore reserves are estimated to contain 6,660,091 ounces of silver. About 2,781,400 ounces of these reserves are under the waters of Kerr lake, and will no doubt be made accessible should the lake be drained, as is proposed. The output from the mine for the year ending 31 August, 1911, was 2,269,680 ounces, and President J. A. Lewisohn speaks of the future of the property as follows: "While it was thought wise, in order to conserve the resources of the company, to reduce production, yet we believe, from data on hand, that the ore reserves are sufficient to last for one or two years at the present rate of production."

Below is given a list of the mines producing silver in 1912, with the post office address of the manager or other officer in charge of the property. The order of arrangement is alphabetical:

Silver Producing Companies

Name of Company or Owner.	Name of Mine	Locality.	P. O. Address of Manager, etc.
Bailey Cobalt Mines, Limited	Bailey	Cobalt	Giroux Lake.
Beaver Consolidated Mines, Limited	Beaver	Cobalt	Cobalt.
Buffalo Mines, Limited, The	Buffalo	Cobalt	Cobalt.
Casey Cobalt Silver Mining Company, Limited	Casey-Cobalt	Casey Township	New Liskeard.
Chambers-Ferland Mining Company, Limited	Chambers-Ferland	Cobalt	Cobalt.
City of Cobalt Mining Company Limited	City of Cobalt	Cobalt	Cobalt.
Cobalt Lake Mining Company, Limited	Cobalt Lake	Cobalt	Cobalt.
Cobalt Provincial Mining Company, Limited	Provincial	Cobalt	Cobalt.
Cobalt Townsite Mining Company, Limited	Townsite	Cobalt	Cobalt.
Colonial Mining Company, Limited	Colonial	Cobalt	Cobalt.
Coniagas Mines, Limited, The	Coniagas	Cobalt	Cobalt.
Crown Reserve Mining Company, Limited	Crown Reserve	Cobalt	Cobalt.
Drummond Mines, Limited	Drummond	Cobalt	Cobalt.
Hargrave Silver Mines, Limited	Hargrave	Cobalt	Cobalt.
Hudson Bay Mines, Limited	Hudson Bay	Cobalt	Cobalt.
Kerr Lake Mining Co., Limited	Kerr Lake	Cobalt	Cobalt.
La Rose Mines, Limited	La Rose, Lawson, Princess, etc.	Cobalt	Cobalt.
McKinleyDarragh-Savage Mines of Cobalt, Limited	McKinley-Darragh, and Savage	Cobalt	Cobalt.
Millerett Silver Mining Company, Limited	Millerett	Gowganda	Gowganda.
Nipissing Mining Company, Limited	Nipissing	Cobalt	Cobalt.
O'Brien, M. J.	O'Brien	Cobalt	Cobalt.
O'Brien, M. J.	Miller Lake-O'Brien	Gowganda	Gowganda.
Penn-Canadian Mines, Limited	Penn-Canadian	Cobalt	Cobalt.
Right-of-Way Mines, Limited	Right-of-Way	Cobalt	Cobalt.
Ryckman, E. B.	Mann	Gowganda	Gowganda.
Seneca-Superior Silver Mines, Limited	Seneca-Superior	Cobalt	Cobalt.
Temiskaming Mining Company, Limited	Temiskaming	Cobalt	Cobalt.
Tretbewey Silver Cobalt Mines, Limited	Tretbewey	Cobalt	Cobalt.
Wettlaufer Lorrain Silver Mines, Limited	Wettlaufer	South Lorrain	Silver Centre.

Cobalt

The opening of the silver mines of the Cobalt district has changed the course of the world's trade in cobalt. The chief use of cobalt is as a coloring material in the manufacture of fine chinaware, and the largest users are the great porcelain makers of Germany, France, and England. For this purpose it is employed in the form of cobalt oxide, CoO, the theoretical composition of which is 78.66 per cent. by weight of cobalt, and 21.34 per cent. of oxygen. Commercially, however, the proportion of cobalt is considerably lower. The commoner form is black oxide, which contains from 68 to 71 per cent. of cobalt; some manufacturers prefer the gray oxide, which may contain 73, 74, or even 75 per cent. of cobalt. A small percentage of nickel, or of the other constituents of the original ore, is not considered deleterious.

The Market for Cobalt

Formerly, about 250 tons of cobalt oxide was sufficient to meet the annual requirements of the trade, and until the discoveries at Cobalt, the chief source of supply was New Caledonia, an island possession of France, in the South Pacific Ocean. It has sold as high as $4.00 per pound, but at the time of the opening of the Cobalt mines, the price was about $2.50 per pound. Primarily, of course, the Ontario mines are worked for silver, but the ore contains much cobalt, and in the process of recovering the silver, the cobalt must be dealt with. Refiners of the ores from the Cobalt mines had perforce therefore to grapple with the problem of obtaining a commercial product, and this in the face of a rapid and severe fall in the value of cobalt oxide, brought about by the over-supply of ore from the Cobalt mines. The usual difficulties were encountered accompanying the effort to wrest a well-established trade from its customary channels, which were not lessened by the complex and refractory nature of the raw material. These difficulties, however, have been surmounted, and at the present time, cobalt oxide from the mines of Cobalt is supplying the larger part of the world's need of this article, New Caledonia having temporarily, at any rate, ceased production.

As a natural result of the lowering of the price, which is now about three shillings a pound, the consumption of cobalt oxide has materially increased. It is being used more largely than before in the ceramic trade, and in the manufacture of the commoner and cheaper varieties of ware, not only for actual coloring purposes, but to correct the yellowish tone of the goods and to impart to the white a clearer hue. It seems likely, too, that in the manufacture of certain alloys, metallic cobalt will yet find a large outlet. Particulars were given in a previous Report of the experiments by Mr. Elwood Haynes, of Kokomo, Indiana, in perfecting an alloy of cobalt and chromium named by him, "stellite," which exhibited qualities promising much usefulness in the manufacture of cutlery, cutting tools for lathes, etc. Certain German steelmakers have also placed orders for considerable quantities of oxide, presumably for use in articles of their own manufacture. In so far, however, as the employment of cobalt is founded upon qualities which it possesses in common with its sister metal, nickel, it would seem that its use must be restricted by its higher price.

There is but a small market for cobalt oxide on the continent of America, possibly not more than fifty tons annually, and the export by the Ontario refiners is to England, France and Germany. A considerable quantity of the oxide is exported in the form of the finished article ready for use, and much more as cobalt oxide mixed with nickel oxide, which the English and European manufacturers refine, separating the cobalt from the nickel. The former oxide is then sold by the manufacturers under their own brands.

Bounties on Cobalt Oxide

Under the terms of the Metal Refining Bounty Act, 7 Edward VII., chapter 14, a bounty of six cents per pound is paid on the metallic cobalt contents of cobalt oxide made in the Province. The term for this bounty provided in the original Act was five years, from 10th April, 1907, but in the session of 1912, the Legislature extended the term for another period of five years, which will expire on 10th April, 1917. The following sums were earned by refineries in the Province under the terms of this Act in 1912:—

Name of Company.	Location.	Cobalt Oxide produced	Metallic Cobalt contents	Bounty
		lb.	lb.	$
Deloro Mining and Reduction Co., Limited.	Deloro......	24,224	16,634.62	998.07
Coniagas Reduction Co., Limited	Thorold	202,325	143,306.79	8.958.40
Dominion Refineries, Limited	North Bay..	1.550	1,043.31	62.59
Total............................	....	228,099	160.984.72	10,019.06

Provision is also made in the Metal Refining Bounty Act for bounties on refined nickel, nickel oxide, copper, and arsenic made from mispickel ores not carrying cobalt. With the exception of nickel oxide, no claims have yet been presented for bounty on any of the other products mentioned in the Act.

A considerable quantity of cobalt in the form of "crude cobalt material," otherwise residues, was exported by the Canadian Copper Company and the Canadian Refining and Smelting Company, at whose plants the process was not carried to the point of producing the oxide.

It is doubtful whether the demand for cobalt oxide, even with such additional outlets as have yet been provided, will prove sufficient to absorb the entire cobalt product of the mines saved in treating the ore. In various quarters there are on hand accumulations of cobalt-containing material, and these will necessarily be added to by the operation of those plants in the cobalt field itself where nothing save bar silver is now being turned out. There are silver-free veins of cobalt ore now unworked, and from these and in the course of mining operations generally, much larger supplies of cobalt ore could be obtained were it required, and were a stimulus applied in the way of a price per pound for the cobalt contents. As it is at present, the mine-owner receives nothing for the cobalt his ores may contain.

Nickel

There are now three sources of nickel supply in Ontario:—(1) The mines of the Sudbury district, (2) the Alexo mine in Dundonald township, (3) the ores of the Cobalt silver camp. The last-named is of little commercial moment; the second is significant as indicating the possibility of nickel in quantity being found outside of the recognized area; while the first is the chief source, and one rapidly growing in output and importance.

There were raised from the mines of Sudbury in 1912, 735,656 tons of ore and from the Alexo mine (treated at the Mond Company's works) 1,792 tons, or 737,656 tons in all. The ore was taken from the following deposits:—

	Tons.	Tons.
Canadian Copper Company:		
Creighton mine	518,417	
Crean Hill mine	33,507	
No. 2 mine	66,372	
		618,296
Mond Nickel Company:		
Victoria No. 1 mine	34,287	
Garson mine	83,281	
Alexo mine	1,792	
		119,360
Total		737,656

There was charged into the smelting furnaces 725,065 tons, the product of which was 41,925 tons of Bessemer matte, containing 22,421 tons of nickel. The value of the nickel contents was returned as $4,722,040, or about 10.5 cents per pound. As compared with 1911, the production of matte was greater by 9,318 tons and of nickel by 5,372 tons, being in fact the largest output of any year since the industry was established. The nickel contents of the ore, computed on the basis of the quantity of matte produced, were 61.8 pounds per ton of 2,000 lb., or 3.09 per cent., exclusive of the losses in roasting and smelting.

Progress of Nickel Mining

The demand for nickel was active throughout the year, and the two producing companies—the Canadian Copper Company and the Mond Nickel Company—were fully employed. Both indeed have had to increase their facilities for production. The Copper Company has enlarged and improved its plant at Copper Cliff, and the Mond Company has for some time had under construction a new smelter at Coniston, near the point where the Canadian Northern railway crosses the line of the Canadian Pacific, east of Sudbury. When these works are completed, which will probably be in the spring of 1913, the company will abandon their present site at Victoria mines, and move their entire plant to Coniston, which has the advantage of greater proximity to their Garson mines, now the main source of the company's ore supply.

The indications are that a third company will soon be producing nickel. The holdings of the Dominion Nickel Copper Company, of which company Mr. J. R. Booth, of Ottawa, and Mr. M. J. O'Brien, of Renfrew, were leading members, have been bought by interests represented by Messrs. Holmes and Wilson. These holdings included the Whistle and other properties on the northern nickel range and the Murray mine, the first deposit discovered in the Sudbury district, formerly owned and worked by the Vivians, of Swansea, but idle for many years; also the Gertrude and Elsie mines, formerly held by the Lake Superior Corporation. The new concern is erecting a smelter at the Murray mine capable of treating 1,500 tons of ore per day, so constructed as to admit of ready enlargement to 5,000 tons capacity. Bessemer matte of the type produced by the companies now operating will be turned out, and there is a possibility that the nickel may be refined in Ontario by the Hybinette process, the rights of which for the American continent are owned by the newcomers.

Results of much significance have been obtained from extensive exploration of the Sudbury nickel fields by diamond drill borings. These have been carried on by all three companies. At the Murray mine, same distance from the old workings, a large body of ore has been found, the existence of which was unknown to the original owners. Owing to this discovery, the site of the proposed works has been changed from Blue lake, near the Whistle mine, to the Murray. At what is known as the No. 3 or Frood mine, the Canadian Copper Company have had a number of drills at work for over two years, and the borings have revealed an extensive ore deposit, stated to be larger than even the Creighton. The company have constructed a railway from Copper Cliff to the Frood mine, and are putting down a four-compartment incline shaft and a three-compartment vertical shaft in order to develop the deposit. They are planning to extract some 10,000 tons per day from this mine. Frood extension, immediately north of the Frood proper, is owned by the Mond Nickel Company. The ore body crosses into the Mond ground, and the latter are sinking a shaft to intercept it at a depth of 800 feet. It is hardly too much to say that these developments have placed the Sudbury nickel field in a position of complete dominancy with regard to the production of this metal.

The quantity of nickel recovered from the ores of the Cobalt silver mines can only be estimated, but in any event it is not large. At the proportion of nickel assumed in this Report, namely, 1.47 per cent., nickel contents of the 1912 production would be about 429 tons. Part of this is wasted in the smelting of the ores by the United States refining plants, part of it is separated as nickel oxide in Ontario, and part is exported mixed with cobalt oxide for final treatment by the cobalt oxide makers of Europe, and no doubt is recovered in their works. The quantity of nickel oxide produced and marketed as such last year by the home refiners was 117,160 lb., containing 78,392.20 lb. metallic nickel, the bounty paid on which at the rate of 6 cents per pound of metallic nickel was $4,703.53. The nickel contents of the Cobalt ores would appear to have yielded to mine-owners and Ontario refiners in 1912 some $14,220, and this amount is reckoned in these statistics as the money equivalent of the 429 tons mentioned above.

New uses for nickel are being found from time to time. The Sydney (Australia) correspondent of the *Mining Journal* (London, Eng.), of 10th May, 1913, states that specimens of a new alloy called "Ormiston metal" have recently been shown in that city. The composition is 90 per cent. aluminium and 10 per cent. nickel. "Ormiston metal" is described as approaching aluminium in lightness. It can, it is said, be turned out as soft as copper or as hard as steel; can be soldered or brazed on another metal; in tensile strength it is equal to mild steel; it does not tarnish; and a piece kept in sea-water for many weeks showed no sign of corrosion.

The course of the nickel industry during the five years beginning with 1908 is shown by the following table:—

Table No. VIII.—Nickel-Copper Mining, 1908 to 1912.

Schedule.		1908	1909	1910	1911	1912
Ore raised	tons	409,551	451,892	652,392	612.511	737,656
Ore smelted	"	360,180	462,336	628,947	610.788	725,065
Bessemer matte produced	"	21,197	25,845	35,033	32.607	41,925
Nickel contents	"	9,563	13,141	18.636	17.049	22,421
Copper contents	"	7,501	7,873	9,630	8,966	11,116
Value of Nickel	$	1,866,059	2,790,798	4,005,961	3,664.474	4,722,040
Value of Copper	$	1,062,680	1,122,219	1,374.103	1,281,118	1.581.062
Wages paid	$	1,286,265	1,234,904	1,698.184	1,830,526	2,357.889
Men employed	No.	1,680	1.796	2,156	2,439	2,850

The nickel mining concerns carrying on active work are:—

Name of Company.	Name of Mine.	Location.	P.O. Address of Manager, etc.
Canadian Copper Company	Creighton, Crean Hill, No. 2, etc.	Sudbury	Copper Cliff
Mond Nickel Company, Limited	Victoria, Garson	"	Coniston
Holmes and Wilson	Murray, Whistle, etc	"	Toronto
E. F. Pullen	Alexo	Dundonald Tp.	Cochrane

Copper

The copper product of Ontario for 1912 was 11,126 tons, all of which save 10 tons was from the nickel-copper mines of Sudbury. A quantity of copper ore containing about 7 tons of metal was encountered in the workings of the Temiskaming silver mine at Cobalt, and the remaining 3 tons of non-Sudbury origin was obtained by the Dane Mining Company from a prospect near the station of that name on the T. and N. O. railway.

According to the figures supplied the Bureau by the nickel companies, the 41.925 tons of Bessemer matte turned out by the blast furnaces and converters of Sudbury contained 33,537 tons, or 80 per cent. of nickel and copper. Of this 1,069 lb. per ton or 53.45 per cent. was nickel, and 530 lb. or 26.5 per cent. copper. Calculated on the quantity of ore smelted, 725,065 tons, the resulting matte showed the ore to contain 3.09 per cent. nickel and 1.53 per cent. copper. These figures, of course, take no account of losses of metal at any stage of the process of treatment. There is probably an appreciable loss of copper during heap-roasting of the ore in the open air, due to the leaching action of rain or snow falling upon the heaps; also a loss in the smelting itself.

Platinum and Palladium

It is known that the Sudbury ores carry not only nickel and copper, but also a proportion of the precious and rarer metals, including gold, silver, platinum and palladium. Cobalt is likewise a constituent, but since the opening up of so prolific a source of supply of this metal in the silver mines of Cobalt, there is no inducement to recover the small proportion of cobalt contained in the Sudbury pyrrhotites. The rare metal rhodium, which is almost invariably contained in crude platinum to the extent of about

2 per cent., and which is at present worth $5 per gram, or $155 per ounce, is also present in these ores, and a little is said to be produced in the United States, partly from platinum sand, and partly from Canadian and other copper bullion.* Another rare metal, ruthenium, an accompaniment of the mineral iridosmine, is also said to occur in the copper ores of Sudbury.†

The platinum is present in the unaltered ores of Sudbury as sperrylite, or arsenide of platinum, and it has been definitely ascertained by T. L. Walker and Charles W. Dickson, to be associated with the chalcopyrite. The increasing demand for platinum, due to its extensive use for laboratory utensils, and also to its employment of late in the manufacture of jewellery, has caused a very decided rise in price, which went up from $21.27 per ounce in 1908, to $43.62, in 1911, remaining at about the same figure in 1912. There has been little or no increase in the supply, the bulk of which, about 300,000 ounces annually, comes from the Ural mountains in Russia. Colombia, with 11,750 ounces in 1912, ranks second as a producer, and smaller quantities are recovered in the placers of northern California, western Oregon, and British Columbia. Under these circumstances any source of supply is important.

Through the courtesy of the International Nickel Company, it is learned that during the six years, 1907 to 1912, inclusive, 2,366.47 ounces of platinum, and 4,216.482 ounces of palladium were recovered at the Orford refining works of that company in New Jersey, while refining the mattes produced by the Canadian Copper Company from the nickel-copper ores of the Sudbury district. No part of this production was previously reported to the Bureau, and hence it has not been covered by statistics previously issued. Under these circumstances, and although not strictly correct, the figures for the six years have been included in those for the year 1912, as the only practicable method of incorporating them in the official record of production. The platinum has been valued at the average price for the several years, and the palladium has been accorded the same figure. The former amounts to $80,736, and the latter to $147,235.

Palladium is a white metal, intermediate in color between platinum and silver. In hardness it is about equal to platinum. It is malleable, ductile, sectile, and dissolves in nitric acid. Palladium finds a use in parts of astronomical instruments, in watchmaking, dental work, and in soldering platinum metals. Not being altered or discoloured by exposure to air or hydrogen sulphide, it is often used for plating metal ware. The demand is greater than the supply.

It should be added with regard to this production of platinum and palladium, and also gold and silver from the same source, that owing to certain residues from ores from other districts and of different character, which form part of the smelting charge at the Orford works, along with the nickel-copper mattes, it cannot be stated with absolute definiteness that the elements in question are wholly derived from the Sudbury ores; it is, however, believed that they are largely traceable to the latter.

Iron Ore

Iron ore was shipped from three mines during the year 1912—Moose Mountain, Bessemer, and Helen—amounting to 117,357 tons. The Moose Mountain and Bessemer ore is magnetite, while the Helen ore is hematite. The production was considerably smaller than in 1911, when it was 175,631 tons. The Algoma Steel Corporation was actively engaged in developing the Magpie mine, and in installing the roasting plant for the treatment of the sideritic ore of which the deposit is composed. Complete success has not yet been achieved by the process, and the works are not at present in full commercial operation. The Atikokan Iron Company operated the Atikokan mine (magnetite) for a time, but shipped no ore, and the old Belmont or Ledyard mine, in the township of Belmont, Peterborough county, has been taken over by the Buffalo Union Furnace Company, who are carrying out a systematic development of the property. At the Moose Mountain a Gröndal plant for magnetic concentration of the leaner portions of the ore body and the production of briquettes has been installed, and it is expected that both ore and briquettes will be placed on the market during the present year. Of the shipments from the Moose Mountain about 35,000 tons were taken from the stock pile, the remainder being mined during the last four months of the year. Some 45,000 tons were sent to the Columbus Iron and Steel Company, Cleveland, Ohio; 5,000 to the Standard Iron and Steel Company, Deseronto, Ont., and 1,263 tons of briquettes were forwarded to Key Harbour, and held there, as against sales for 1913. Mr. J. W. Evans, of the Tivani Electric Steel Company, Limited, did considerable development work at the Orton mine in Hastings county, the ore of which carries 1 to 3 per cent. of titanium. It is Mr. Evans' intention to utilize this ore in the manufacture of steel by means of an electric furnace, which he has himself devised.

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*The Production of Platinum and Allied Metals in 1911, by Waldemar Lindgren, U. S. Geol. Survey, p. 19.

†Ibid, p. 19.

The following is a list of the iron mining companies at work last year:—

Name of Company.	Name of Mine.	Locality.	P. O. Address of Manager, etc.
Moose Mountain, Limited	Moose Mountain	Hutton township.	Sellwood.
The Canada Iron Mines, Limited	Bessemer	Hastings county.	Trenton.
The Algoma Steel Corporation, Limited	Helen	Michipicoten	Helen Mine.
The Algoma Steel Corporation, Limited	Magpie	Michipicoten	Magpie Mine.
Buffalo Union Furnace Company	Belmont	Peterboro' county	Cordova Mines.
Atikokan Iron Company Limited	Atikokan	Thunder Bay	Port Arthur.
Tivani Electric Steel Company, Limited	Orton	Hastings county.	Belleville.

Pig Iron and Steel

From the blast furnaces of Ontario last year there was turned out 589,593 tons of pig iron, having a value of $8,054,369, the pig being worth at the furnace on an average $13.66 per ton. Of the product, 567,892 tons were coke iron, and 21,701 tons charcoal iron, the latter being made at the Standard Iron Company's furnace at Deseronto. Of the nine furnaces in the Province, eight were in blast as follows:—Algoma Steel Corporation, Limited, Sault Ste. Marie, 3; Canada Iron Corporation, Limited, Midland, 2; Steel Company of Canada, Limited, Hamilton, 2; Standard Iron Company, Limited, Deseronto, 1. The Atikokan Iron Company's furnace at Port Arthur, was idle throughout the year. Steel to the amount of 457,817 tons, valued at $8,071,339, was made by the Algoma Steel Corporation and Steel Company of Canada, in the manufacture of which pig iron, produced by these companies, to the extent of 312,709 tons, was utilized, besides 17,372 tons of pig iron purchased from other makers. The number of workmen employed in the making of pig iron only was 846, to whom wages were paid aggregating $636,420. This does not include employees in the steel-working departments, who numbered 2,179. Bessemer and basic steel are made at Sault Ste. Marie; at Hamilton, basic open hearth. Electro Metals, Limited, Welland, carry on the manufacture of ferro-silicon in electric furnaces, of which they had five in operation during the year. They employed one hundred men and paid out in wages the sum of $70,000.

To produce the above quantity of pig iron, 1,133,660 tons of iron ore were charged into the furnaces, along with 22,252 tons of scale and mill cinder. Of this quantity of ore only 71,589 tons were the product of Ontario mines, all the rest being ore imported from the United States. The proportion of Ontario ore used in making pig iron in this Province is not increasing. On the contrary, it is decreasing steadily. In 1901 it amounted to 56 per cent.; in 1903 it fell to 22.5 per cent.; in 1905 to 19.3 per cent.; rose in 1907 to 23.6 per cent.; in 1909 to 28.7 per cent., and fell again in 1910 to 17.4 per cent.; in 1911 to 7.3 per cent., and in 1912 to 6.3 per cent

The development of the iron mines of the Province is not keeping pace with the expansion of the iron smelting industry For this there are several reasons. One is the ease with which supplies of iron ore of known quality and required composition can be procured from the Lake Superior region south of the line, and another is the comparatively small number of mines which have yet been opened in this Province. There are many iron ranges in Ontario, and if the conditions in Michigan and Minnesota afford any analogy there must be numerous bodies of workable ore contained in these iron-bearing rocks. The fact remains, however, that only a few have yet been located, and it seems as if much energy, skill and money must be expended in the search for ore bodies before the iron ore resources of the Province will be placed in a position to respond to the requirements of the smelting trade.

Particulars of the pig iron and steel manufacture for 1912 are given in the following figures, and for the sake of comparison, for the year 1911 as well:—

	1911.	1912.
Ontario ore smelted, tons	67,631	71,589
Foreign ore smelted, tons	848,814	1,062,071
Scale and mill cinder, tons	18,476	22,252
Limestone for flux, tons	275,628	305,509
Coke for fuel, tons	577,388	660,248
Value of ditto	$2,367,704	$2,584,766
Charcoal for fuel, tons	1,666,897	1,886,748
Value of ditto	$158,354	$157,597
Pig iron product, tons	526,610	589,593
Value of ditto	$7,716,314	$8,054,369
Steel product, tons	361,581	457,817
Value of ditto	$9,505,013	$8,071,339
Workmen employed, number	3,633	2,925
Wages paid	$2,927,573	$2,383,029

The steady growth of the pig iron and steel making industry during the past five years is sufficiently shown by the following table:—

Table IX.—Production Iron and Steel, 1908 to 1912

Schedule.		1908	1909	1910	1911	1912
Ontario ore smelted	tons	170,215	220,307	143,284	67,631	71,589
Foreign ore smelted	"	342,747	543,544	678,890	848,814	1,062,071
Limestone for flux	"	179,741	226,991	248,750	275,628	305,509
Coke	"	322,817	436,707	471,493	577,388	660,248
Charcoal	bush	....	973,413	1,133,419	1,666,897	1,886,748
Pig iron	tons	271,656	407,013	447,351	526,610	589,593
Value of pig iron	$	4,390,839	6,301,528	6,975,418	7,716,314	8,054,369
Steel	tons	172,108	296,031	331,321	361,581	457,817
Value of steel	$	4,397,082	6,759,960	7,855,407	9,505,013	8,071,339

From the figures given for the operations of 1912 it would seem that, disregarding scale and mill cinder, 1.92 tons of ore were required to produce one ton of coke pig iron, also .53 ton of limestone, and 1.16 tons coke. For a ton of charcoal pig, the materials were, 1.90 tons ore, .114 ton limestone, and 8.35 bushels charcoal.

Following are the blast furnace companies producing pig iron in Ontario:—

Name of Company.	No. of Furnaces.	Fuel used.	Location.
Algoma Steel Corporation, Limited	3	Coke	Sault Ste. Marie.
Steel Company of Canada, Limited	2	"	Hamilton
Canada Iron Corporation, Limited	2	"	Midland.
Atikokan Iron Company, Limited	1	"	Port Arthur.
Standard Iron Company, Limited	1	Charcoal	Deseronto.

Materials of Construction

Building operations in the towns and cities of Ontario were again active, and there was an increased production of brick and stone. At the same time, however, the output of Portland cement fell off slightly, and there was a decrease in the quantity of lime produced.

Brick

Returns to the Bureau show that the brick kilns of the Province turned out 385,000 M common brick in 1912, valued at $3,178,250, as against 354,546 M in 1911 worth $2,801,971 —an increase in number of 30,454 M or 8.58 per cent., and in value of $376,279, or 13.42 per cent. It will be seen that the increase in cost was considerably greater than the increase in number, and this is further brought out by a comparison of the price per M which in 1911 was $7.90 and in 1912 $8.20. It is a truism now to state that the cost of living has gone up of late years; but common building brick, which in this country and climate may fairly rank as a necessary of life, well illustrates the tendency to higher levels of cost. In 1901 ordinary brick were worth $5.73 per M.; in 1905 the price had risen to $7.75; in 1909 it was $7.78; in 1911, $7.90, and in 1912, $8.20.

The manufacture of paving brick does not seem to be increasing in Ontario. Objection is taken to them because of their noisiness, and if they are not well made of suitable material, they fail to provide a durable pavement. The value of their production last year was $78,195, as against $86,685 in 1911. Terra cotta, worth $137,239 and fancy brick valued at $6,552, made up a total of $221,986.

Pressed, or re-pressed, brick is highly esteemed for its colour and finished appearance, and the number made rose to 65,598 M in 1912 valued at $634,169, as compared with 52,764 M in 1911 valued at $564,630.

The brick statistics of 1912 may be summarized as follows:—

	M.	Value.
Common brick	385,000	$3,178,250
Paving brick or blocks	4,229	78,195
Terra cotta building blocks	3,637	137,239
Fancy brick	216	6,552
Pressed brick	65,598	634,169
Total	458,680	$4,034,405

The number of men employed in the making of bricks and drain tile was 3,314, who received wages amounting to $1,399,096.

The value of the drain tile made in 1912 was less than in 1911, being $279,579 as compared with $349,545.

Other manufactures of clay were sewer pipe and pottery, the value of the former in 1912 being $464,627, an increase over 1911 of $54,563, and of the latter $52,445, an increase of $1,945.

About six million sand-lime brick were returned for 1912, valued at $50,277, or $8.50 per thousand.

Extracts from the remarks made on their returns by brick and tile manufacturers are interesting. In some places on the north shore of Lake Erie, natural gas is used to fire the kilns. The season of 1912 was wet; rain hampered operations, and was productive of delay and loss. Statements such as the following show how the scarcity of labour in the rural districts is interfering with local industries: "Works were idle part of the time for repairs and lack of help." "Could not get men; think I will have to quit the business on account of labour." "Only worked three months in the year. We had a gang of Italians, and they all left us at once, and we could not get another gang, times are so good for the men." This from a small manufacturer is surely a unique case:— "Labour all performed by my daughter and myself."

About 40 per cent. of all the brick made in the Province is manufactured in the yards on the outskirts of Toronto, which is a city of brick, and in which many millions of dollars have been spent during the last few years in building operations. In capacity these plants range upwards from two million brick per annum. Some turned out five million in 1912, some eight million, one fifteen million, and one—the Don Valley Brick Works—upwards of forty-three million. The average output of 23 yards was 6,900,000 brick. The local supply was insufficient last year to meet the demand, and quantities were shipped in from outside points.

Sewer Pipe

Three sewer pipe manufacturing companies turned out a total of $464,627 worth of pipe last year. This was an increase of $54,563 over the production of 1911. The rapid growth of the towns and cities of Ontario provides a good market for the output.

Pottery

The manufacture of pottery from Ontario clays is not keeping pace with the expansion experienced by other branches of the clay-working industry. Only the coarser and commoner articles, such as flower-pots, hanging baskets, jardinieres, etc., are made from the native clay, any finer varieties of ware requiring the use of imported material. It is not to be wondered at that in a region such as Ontario where there are no coal beds with their seams of fire-clay, and where glaciation has been so active a force in the formation of the present surface, there should be a scarcity of clays sufficiently free from fluxing agents to be suitable for fine porcelain and chinaware. Kaolinic clays have been reported from the valleys of several of the rivers running down the James Bay slope, but in the absence of transportation facilities no attempt has yet been made to test their adaptability for pottery purposes. The value of the pottery turned out by the half dozen potteries reporting their production in 1912 was $52,445, as compared with $50,500 in 1911.

List of Clay-Working Plants

Below is a list of the clay-working plants with particulars as to kinds of goods manufactured:—

Name.	Address.	Manufacture.
Arnold, Willard	Virginia	Brick.
Adamson, William	Walkerton	Brick.
Armstrong, G. H.	Wheeler	Tile.
Allen, Solomon	Brantford	Brick.
Ashbridge Brick Company	Toronto	Brick.
Alsip Brick & Tile Co.	Fort William	Brick and tile.
Boone, George H.	Thornbury	Brick.
Baker Bros.	Casselman	Brick.
Brownscombe & Sons, H.	Cargill	Brick and tile.
Baker, George E.	Arnprior	Brick and tile.
Beckett, E. C.	Orwell	Brick and tile.
Bechtels, Limited	Waterloo	Brick.
Bell Bros	Paisley	Brick and tile.
Bell Bros.	Drew	Tile.
Baird & Son, H. C.	Parkhill	Brick and tile.
Burgess, Charles F.	Carleton Place	Brick.
Blake, W. C.	Nairn	Brick and tile.
Blake, Elias D.	Elginfield	Tile.
Beamsville Brick & Terra Cotta Co.	Beamsville	Pressed and fancy brick.
Barnhardt, W. H.	Monkton	Brick.
Beaverton Brick and Tile Co., Limited	Beaverton	Brick and tile.
Bechtel, W. B.	Waterloo	Brick and tile.
Bell, John H.	Fulton's Mills	Brick.
Bell Bros. & Co.	Toronto	Brick and tile.
Bemrose, Thos.	Beeton	Brick and tile.
Berlin Brick Co.	Berlin	Brick.
Bowler, Wes.	Markdale	Brick.

List of Clay-Working Plants—Continued

Name.	Address.	Manufacture.
Bracebridge Brick Co.	Bracebridge	Brick.
Brampton Pressed Brick Co., Limited	Brampton	Pressed brick.
Brandon Pressed Brick & Tile Co.	Milton	Brick and tile.
Brick Mnfg. & Supply Co., Limited	London	Brick.
Brown, John W.	Vienna	Brick.
Belleville Pottery Company	Belleville	Pottery.
Broadwell, B.	Kingsville	Brick and tile.
Bond & Bird	Woodstock	Brick.
Baeckler, William	Chesley	Brick.
Buck, J. L.	Port Rowan	Brick and tile.
Brantford Brick Company	Brantford	Brick.
Brown, Edwin	Bronte	Brick and tile.
Bushell, William	Toronto	Brick.
Brown, J. A.	Mount Dennis	Brick.
Butwell Brick Co., Limited	Toronto	Brick.
Brown Bros. Brick Co.	Mount Dennis	Brick.
Big Four Brick Co., Limited	Toronto	Brick.
Cabana, Jr., Oliver	St. Joseph	Brick and tile.
Canada Sand Lime Pressed Brick Co.	West Toronto	Sand lime pressed brick.
Card, N. B.	Harrisburg	Brick and tile.
Caswell, Edgar	Cobden	Brick.
Campbell, Neil F.	West Lorne	Brick.
Cherrett, E.	Woodstock	Brick.
Clemen, Moses	Croton	Brick and tile.
Conway, Frank P.	Stratford	Brick and tile.
Cornhill, James, & Son	Chatham	Brick and tile.
Crain, Geo.	Beamsville	Pressed brick.
Cranston, and Sons, J.	Hamilton	Pottery.
Crawford Bros.	Hamilton	Brick.
Crone, R., & Son	Collingwood	Brick.
Crowhurst, Walter J.	Port Hope	Brick.
Cumberland, John M.	Listowel	Brick.
Curtin, Francis	Lindsay	Brick.
Curtis Bros.	Peterborough	Brick.
Davenport, B. F.	Orwell	Brick and tile.
Davis and Son, John	Davisville	Pottery.
Deller and Sons	Norwich	Brick and tile.
Dodge, Geo.	Kerwood	Tile.
Dominion Sewer Pipe Co., Ltd., The	Aldershot	Brick and sewer pipe.
Deller Bros.	London, R. D. 3	Brick and tile.
Don Valley Brick Works	Toronto	Common, plain and fancy brick, terra cotta.
Dominion Sewer Pipe Co., Limited	Swansea	Sewer pipe.
Dahmer, H. D.	Conestogo and Elmira	Brick.
Davisville & Carlton Brick Mnfg. Co.	Davisville	Brick.
Deller, Albert	Ingersoll	Brick.
Deterling, Mrs. E.	Humberstone	Brick.
Draper Bros.	Huntsville	Brick.
Dryden Timber & Power Co., Limited	Dryden	Brick.
Dumas, Geo. W.	Fletcher	Brick.
Dublin Brick and Tile Works	Dublin	Brick and tile.
Dungey Bros.	Wartburg	Brick.
Dunlop & Schmidt	Pembroke	Brick.
Eddie, Joseph	Bracebridge	Brick.
Elliott, Wm.	Glenannan	Brick.
Elliott, Eli	Wingham	Brick.
Elliott & Sons, James	Steelton	Brick.
Emard, T.	Embrun	Brick.
Entricken, F. W.	Tavistock	Brick.
Esterbrook, W. H.	Freeman	Brick.
Farah, K.	New Liskeard	Brick.
Forman, J. H.	St. Mary's	Brick.
Fort William Brick and Tile Co.	Fort William	Brick and tile.
Fox, S. J., Estate of	Lindsay	Brick and tile.
Fox, G. J.	Dresden	Brick and tile.
Frank, C. G.	Strathroy	Brick.

List of Clay-Workin Plants—Continued

Name.	Address.	Manufacture.
Fraser & Logan	Blyth	Brick and tile.
Fuller, Geo.	Dracon	Tile.
Frid Bros.	Hamilton	Brick.
Frid Brick Company, Geo.	Hamilton	Brick.
Freek, Wm.	Barrie	Brick.
Frost, Geo. H.	Toronto	Brick.
Foster Pottery Company	Hamilton	Pottery.
Gardiner, Wm.	Blenheim	Brick.
Gowanlock, J.	West Fort William	Brick.
Govanlock, J. M.	Winthrop	Brick and tile.
Haack, E. C.	Drayton	Tile.
Hales, C.	Northwood	Tile.
Hall, Mrs. H.	Cobourg	Brick.
Hallett, H.	Comber	Brick and tile.
Hallman, J. B.	Hanover	Brick.
Hamilton Pressed Brick Co., Limited	Hamilton	Pressed brick.
Hamilton & Toronto Sewer Pipe Co., Limited	Hamilton	Sewer pipe.
Hamley, R. H.	Bowmanville	Brick.
Hancock, Wm.	Hamilton	Brick.
Harbour Brick Co., Limited	Toronto	Brick.
Haw, J. R.	Proton Sta. R. R. No. 1	Brick.
Hicks, D.	Shelburne	Brick and tile.
Hill Bros.	Essex	Brick and tile.
Hill & Co., Jas. S.	Madoc	Brick and tile.
Hinde Bros.	Toronto	Brick.
Hiscock and Sons	Cobonrg	Brick.
Hitch, John	Ridgetown	Brick and tile.
Hohl, Geo.	Lisbon	Brick and tile.
Holton Bros.	Drew	Brick.
Howlett, Fred.	Petrolea	Brick.
Humberston, Thos. A.	Newton Brook	Pottery.
Haileybury Brick & Tile Co., Limited	Haileybury	Brick and tile.
Haist, Fred	Crediton East	Brick.
Haist, Jos.	Crediton East	Brick.
Hooker, D. D.	Welland	Brick.
Irwin, James	Norwich	Brick.
James and Sons, Thos.	Blackwell	Brick and tile.
Jamieson, J. A.	Renfrew	Brick and tile.
Janes, Henry	Delaware	Brick and tile.
Janes, W. B.	Mitchell	Brick and tile.
Jasperson, B.	Kingsville	Tile.
Jemison, J. and A.	Corunna	Brick.
Jervis and Son, John	Dorchester Sta.	Brick and tile.
Johnson, James	Pembroke	Brick.
Johnston, R. and George J.	Putnam	Brick.
Jordan, Daniel	Chatham	Brick and tile.
Kruse Bros.	Egmondville	Brick and tile.
Koebel, Joseph Z.	St. Clements	Brick and tile.
Kuhn, Henry J.	Crediton East	Brick and tile.
Kaar, John	Brownsville	Brick and tile.
Kingston Brick and Tile Co., Limited	Kingston	Brick and tile.
Kerr, Fred	Crediton East	Brick and tile.
Keyser, O. G.	Keyser	Tile.
Lines, J. C.	Earlscourt	Brick.
Lang and Sons, M. K.	Merrickville	Brick.
Lethbridge, W. H.	Steelton	Brick.
Leatherdale, R. W.	Dresden	Brick and tile.
Lowes, Gordon	Chatham	Brick and tile.
Light, Wm.	Aylmer West	Brick and tile.
Lewis, C. J.	Milton	Pressed brick.
Ladouceur, Joseph	Embrnn	Brick.
Lindsay, Stephen	Tupperville	Tile.
Leamington Brick & Tile Co., Limited	Leamington	Brick and tile.
Lochrie, Jas.	Toronto	Brick.
Launders, Thos.	Fruitland	Brick and tile.

List of Clay-Working Plants—Continued

Name.	Address.	Manufacture.
Lowe, Joseph	Meaford	Brick and tile.
Logan, J.	Toronto	Brick.
Lainson & Sons, J. W.	West Toronto	Brick.
London Pottery Mnfg. Co.	London	Pottery.
MacKay Bros.	Dutton	Brick and tile.
Mills, George E.	Hamilton	Brick.
Munro Brick Co.	Pembroke	Brick.
Munro, D. W.	Carp	Brick and tile.
Moody, G. W.	Highgate	Brick and tile.
Marshall, W. W.	Woodstock	Brick.
Miner, J. T.	Kingsville	Brick and tile.
Martin, David	Thamesville	Brick and tile.
Morley and Ashbridge	Toronto	Brick.
Mason, Chas.	Toronto	Brick.
Maloney, John	Toronto	Brick.
Milton Pressed Brick Co., Limited	Milton	Pressed and fancy brick.
Meaford Brick Company	Meaford	Brick.
Merkley Bros.	Casselman	Brick.
Miller, Wm.	St. Joseph	Brick and tile.
Morley, Walker	Toronto	Brick.
Mouldey, Jno.	Kingston	Brick and tile.
McLean, Frank	Brigden	Tile.
McMahon, J. B.	Kerwood	Brick and tile.
McLaughlin, John	London	Brick.
McCredie, W.	Lyons	Brick and tile.
McCormick Bros.	Kingscourt	Brick and tile.
Norton, Alsey	Bolton	Brick and tile.
Norton, Thos. W.	Toronto	Brick.
Nayler and Sons, J. W.	Marmora	Brick.
National Fire Proofing Co. of Canada, Limited	Hamilton	Pressed brick.
Newman, Wm.	East Toronto	Brick.
New, Edward	Hamilton	Brick and tile.
Neal, A., and Son	Seeley's Bay	Brick.
Owen Sound Brick Co., Limited	Owen Sound	Brick.
Ott Brick and Tile Manufacturing Co., Limited	Berlin	Brick and tile.
O'Reilly, T. E.	Ottawa	Brick.
Ontario Sewer Pipe Co., Limited	Mimico	Sewer pipe.
Ottawa Brick Manufacturing Co., Ltd.	Ottawa	Brick.
Ollman Bros.	Hamilton	Brick.
Ontario Paving Brick Co., Limited	Toronto	Paving blocks.
Oakville Pressed Brick Co.	Oakville	Pressed brick.
Ouellette, C. P.	Forest	Brick and tile.
Pitblado and Sons, John	Benmiller	Brick and tile.
Petty C. K.	Cherrywood	Brick and tile.
Parks H. W.	Dresden	Tile.
Pilon, Alex.	Casselman	Brick.
Port Arthur Sand-Lime Brick Co, Ltd.	Port Arthur	Sand-lime brick.
Port Dover Brick and Tile Co., Ltd.	Port Dover	Brick and tile.
Peterborough Sandstone Brick Co., Ltd.	Peterborough	Brick.
Paxton and Bray	St. Catharines	Brick.
Ponsford, A. E.	St. Thomas	Brick and tile.
Phillips, Thomas	St. Helen's	Tile.
Phinn, Geo. E.	Elginfield	Brick and tile.
Prices Limited	Toronto	Brick.
Pears, Wm.	Toronto	Brick.
Price, John	Toronto	Brick.
Port Credit Brick Co., Limited	Port Credit	Pressed Brick.
Paisley and Chisholm	Kingston	Brick and tile.
Peerless Brick and Tile Co.	Ottawa	Brick and tile.
Russell, Joseph	Toronto	Brick.
Rice Bros.	Dresden	Brick.
Russell Brick and Tile Co., Limited	Russell	Brick and tile.
Richardson and Sons, James	Kerwood	Brick and tile.
Richardson and Sons, James	Wyoming	Brick and tile

List of Clay-Producing Plants—Continued

Name.	Address.	Manufacture.
Ries, John	Carlsruhe	Brick and tile.
Rilett and Holmes	Alvinston	Brick and tile.
Reed, Almon	Foxboro	Tile.
Robinet Brick Co.	Sandwich	Brick.
Reid Bros.	Hepworth	Brick and tile.
Ryan & Co., T. M.	Niagara Falls	Brick and tile.
Rilett, David	Oil Springs	Brick and tile.
Red Star Brick and Tile Co.	Stratford	Brick and tile.
Sadler, Frederick Louis	Dublin	Brick and tile.
Schultz Bros. Co., Limited	Brantford	Brick.
Scott, Jas. M.	Meaford	Brick and tile.
Smith and Son, Alex.	Dutton	Brick and tile.
Smith, W. W.	Shallow Lake	Brick and tile
Silicate Brick Co. of Ottawa, Limited	Ottawa E.	Brick.
Smith, Allan, G. C.	Acton	Brick.
Sipprell, J. H.	Wilkesport	Brick and tile.
Superior Brick Co., Limited	Fort William	Brick.
Smith Bros.	Port Elgin	Brick.
Sudbury Brick Co. Limited, The	Sudbury	Brick.
Snelgrove and Co.	Beaverton	Brick and tile.
Souter, G. S.	North Bay	Brick.
Surridge, Fred	Toronto	Brick.
Standard Brick Co., Limited, The	Toronto	Brick.
Sawden Bros.	Toronto	Brick.
Stratford Brick, Tile & Lumber Co. Limited	Stratford	Brick and tile.
Stonehouse, Wm.	West Toronto	Brick.
Steele, Edwin	Vankleek Hill	Brick and tile.
Star Brick Co.	North Bay	Brick.
Sproat, Wm. M.	Egmondville	Brick and Tile.
Smith, W. L.	Drew	Brick and Tile.
Sinden, L. H.	Tillsonburg	Brick and Tile.
Shuttleworth and Co.	London	Brick.
Schaefer, F.	Breslau	Brick and tile.
Schaefer, F.	New Hamburg	Brick and tile.
Stickwood, Chas.	Newmarket	Brick and tile.
Taylor, James	Port Hope	Pottery.
Thornton, John	Perth	Brick.
Taylor Bros.	North Rideau	Brick.
Taylor and Hall	Peterborough	Brick and tile.
Toronto Pressed Brick and Terra Cotta Co., Limited	Milton	Pressed and fancy brick.
Terra Cotta Pressed Brick Co., Ltd.	Terra Cotta	Pressed brick and terra cotta.
Townsley, G. H., & Co.	West Toronto	Brick.
Toronto Fire Brick Co.	Mimico	Brick.
Toronto Brick Co., Limited	Toronto	Brick.
Voakes, E. R.	Wheatley	Brick and tile.
Watson Brick Co.	Bracebridge	Brick.
Weppler, Henry	Hanover	Brick and tile.
Workman, James	Brantford	Brick.
Wood, W. H.	Brockville	Brick.
Wehlann and Son	Aldboro	Brick and tile.
Wehlann, Alfred	Cairo	Brick and tile.
Wagstaff, A. H.	Toronto	Brick.
Willcox Lake Brick Co., Limited	Toronto	Brick.
Wallace and Son, R. W.	North Bay	Brick.
Waite, John E.	Forrester's Falls	Brick and tile.
Wright, Samuel	Chesley	Brick and tile.
Wright, J. C.	Toronto	Brick.
Wilson, R. J.	Gananoque	Brick and tile.
Whittington, Geo.	Napanee	Brick and tile.
West Bros.	Campbellford	Brick and tile.
Webb Co., John E.	Toronto	Brick.
Waide Bros.	London	Brick and tile.
Yack, Louis	Walkerton	Brick.
York Sandstone Brick Co., Limited	West Toronto	Brick.

Lime

The output of lime in 1912 was apparently less than in 1911, being 2,297.525 bushels, worth $381,672, as against 2.469,773 bushels, valued at $402,340. Little difficulty is experienced in obtaining lime for any purpose in the older parts of the Province, where limestone occurs abundantly and in strata of various ages and differing composition. Nearly pure carbonate of lime can be procured in some parts; elsewhere the rock contains magnesia from small quantities up to proportions sufficient to constitute a dolomite. All varieties are used for burning into lime, the idea once prevalent that magnesia injured the quality of the product being now no longer generally held. Formerly, much of the production was from small kilns operated by farmers and their sons during their spare time, or when other work was not pressing; now the number of kilns is smaller, but the individual output has increased. In short, the modern tendency towards concentration of industrial effort has made itself felt in lime-making, as well as in nearly all other kinds of manufacture.

The lime manufacturers reporting to the Bureau were as follows, those whose works were not in operation being marked with an asterisk:—

Name.	Location.
*Appleyard, Albert	Georgetown.
*Alexander, A. S. and W.	Alton.
Annis, George	Orillia.
Bergin, Patrick	Napanee.
Brown, George	Cataraqui.
Callan & Bros., John	Innerkip.
Chestnut, W. D.	Duntroon.
Chalmers, David	Owen Sound.
Cameron, W. M.	Carleton Place.
Canada Lime Company, Limited	Coboconk and Sand Point.
*Christie, Henderson & Company, Limited	Toronto.
Ducket, J. H.	Eugenia.
Delta Lime Company, Limited	Delta.
*Foster, William	Cheltenham.
Foote, Will	Varna.
*Flieler, Ed. J.	Fernleigh.
Harvey, E., Limited	Rockwood.
*Harton, S. L.	Sand Bay.
*Hebert, J.	Casselman.
Higginson & Stevens	Stepney.
*Jelly, H. M.	Bowling Green.
*Jamieson Lime Co.	Renfrew.
Lumsden, G. D.	Holstein.
Leslie, Alfred	Puslinch.
*Marren, John	St. Andrews, West.
*Moore, James	Foxmead.
*Muldoon, J.	Toronto.
Marshall, James	Hamilton.
Milton, Peter	Burnbrae.
McMillan, Fred.	Havelock.
McKenzie Bros.	Lucknow.
MacTernon, Jno.	Dirleton, Torbolton.
McGilvray, James	Durham.
*Ontario Limestone & Clay Co., Ltd.	Belleville.
Poirier, Emerie	Apple Hill.
Parks, C. W.	Troy.
Robillard & Son, H.	Ottawa.
Reeb, John A.	Port Colborne.
Robertson & Co., Limited	Milton.
Smith, John S.	Inverhuron.
Standard Chemical, Iron & Lumber Co. of Canada, Ltd.	Eganville.
Standard White Lime Co., Ltd.	St. Mary's, Guelph and Beachville.
Toronto Lime Company, Limited	Dolly Varden, Limehouse.
Wellman, Albert	Belleview.
*Walker, Jay	Uhthoff.

It will be noticed that, out of 46 firms reporting, 16 were idle during the year, and a number of others burned very little lime. The wet season was in part responsible for the curtailment of production. Thirteen plants produced together more than 75 per cent. of the whole output.

Stone

The stone quarried in Ontario is varied in character, and is used for widely different purposes. For construction material, limestone, sandstone and marble are employed; for use as a flux, limestone is required; for roadmaking, limestone and so-called "trap." Granite and gneiss are also used both in blocks and crushed for building and other work. Limestone, however, largely preponderates. An industry is being developed on the basis of the marbles found in the neighbourhood of Bancroft in the county of Hastings. The serpentines of Darling township, of varying shades of green, are also capable of producing very handsome effects. In value, the stone raised last year amounted to $953,839, an increase of $61,212 over 1911. For an account of the limestone deposits of Ontario, arranged by counties, reference should be had to Part II. of the Thirteenth Report of the Bureau of Mines, 1904, by Prof. W. G. Miller, Provincial geologist.

In the following list is given the name and location of the various stone quarrying concerns reporting to the Bureau for the year 1912, also the kind of stone produced. An asterisk indicates those which were idle during the year:—

Name.	Location.	Kind of Stone.
Aylesworth, J. B.	Newburgh	Limestone.
Bedborough, James	Picton	do.
Bergin, Patrick	Napanee	do.
Britnell & Co.	Burnt River	do.
Bannerman & Horne	Ignace	Granite.
Coughlin, Daniel	Smith's Falls	Limestone.
Cook, J. S.	Wiarton	do.
Canada Iron Corporation, Ltd., The	Midland	do.
Coldwater Stone Quarry & Power Co., Ltd.	Coldwater	do.
Cartmell, Wm.	Thorold	do.
*Central Ontario Granite & Marble Co., Ltd.	Trenton	Marble.
*Canadian Marble Co., Ltd.	Bancroft	do.
Doolittle & Wilcox, Ltd.	Dundas	Limestone.
Empire Limestone Co.	Shisler Point	do.
Farr, C. C.	Haileybury	do.
Fleming, J. H.	Glenwilliams	Sandstone.
Fretz, Jacob	Vineland	Limestone.
Foster, Wm.	Cheltenham	Sandstone.
Gordon & Bruce	Lyndhurst	Granite.
Granite, Crushed & Dimension, Ltd.	Washago	do. (crushed).
Harvey, Geo.	Nanticoke	Limestone.
Hagersville Contracting Co., Ltd.	Hagersville	do.
Hastings Quarry Co., Ltd.	Actinolite	Granite.
Intercities Quarries Co., Ltd.	Port Arthur	Trap.
Kennedy, R. C.	Guelph	Limestone.
Kiraly, Jas.	Crookston	do.
Kingston Penitentiary	Portsmouth	do.
Lytle, Thomas	Alfred Centre	do.
Longford Quarry Co., Ltd.	Longford Mills	do.
Laplante, R.	Embrun	do.
Lally, Estate of M.	Smithville	do.
Murphy, J. S.	Tweed	do.
Marshall, James	Hamilton	do.
Markus & Co.	Pembroke	do.
Maloney, John	Schaw	do.

Name.	Location.	Kind of Stone.
MacDonald	Point Anne	Limestone.
MacRow, Henry	Kingston	do.
McWilliams, R. H.	St. Mary's	do.
*North Lanark Marble & Granite Quarries, Ltd.	Darling Tp.	Marble.
Power City Stone Co., Ltd.	St. David's	Limestone.
Perkin, George A.	Owen Sound	do.
Ontario Rock Co., Ltd.	Havelock	Trap.
Queenston Quarry Co., Ltd.	St. David's	Limestone.
Roddy, John M.	Kingston	do.
Reid, Fenton	Fellows	do.
Robillard, H., & Son	Ottawa	do.
Rubel Bros.	Jordan	do.
Rogers, F., & Co.	Terra Cotta	Sandstone.
Robertson & Co., Ltd.	Milton	Limestone.
Soo Trap Rock Co., Ltd.	Poole Island	Trap.
Sidney Kirby Co., T., Ltd.	Gloucester & Nepean Tps.	Limestone and Sandstone.
St. Mary's Horse Shoe Quarry	St. Mary's	Limestone.
Thames Quarry Co.	St. Mary's	do.
Thibault, E.	Hog's Back	do.
Thunder Bay Contracting Co., Ltd.	Blake Tp.	Diabase.
Tillson, T. W.	Ottawa	Sandstone.
Tietz, William A.	Naber	Limestone.
*Wilson, Geo. S.	Scotch Line	Sandstone.
Wentworth Quarry Co., Ltd.	Vinemount	Limestone.
Webster, James	Galt	do.
Wilk, Herman	Eganville	do.
Webber, John	Byng Inlet	do.
Webb, George F.	Hamilton	do.
Walker Bros.	Thorold	do.
Welland County Lime Works, Ltd.	Port Colborne	do.

The foregoing list does not take in firms or companies quarrying feldspar, quartz, or other materials whose production is given separately and is not included under that of building and crushed stone.

Portland Cement

The Portland cement plants of Ontario last year produced 2,993,367 barrels of cement, worth, at the factory, $3,365,659, being a decrease in production as compared with 1911 of 17,482 barrels, and in value of $74,893. This check is the first which the industry has experienced since it was established in 1891, every year hitherto having shown a decided advance over the preceding one. The average price per barrel also fell from $1.209 to $1.124. A feature of the year was the action of the Dominion Government in reducing the duty by one-half on cement imported from June 1 to October 31 inclusive. The reason assigned for this step was the inability of the plants in Ontario and Quebec to supply the urgent demand for cement from Saskatchewan, Alberta and the west generally, arising not so much from shortness of supply as from the congestion of freight traffic on the railways.

When the manufacture of Portland cement began in this Province, shell marl was invariably the material employed as raw material, along with the clay. A change in the process has taken place, and at present a large proportion of the cement is made from limestone of suitable composition, quarried for the purpose. The substitution of rock for marl is advantageous economically, and the cement does not seem to suffer in quality. It costs less to handle the rock, and there is not so much moisture to eliminate.

The plants in operation last year were fourteen in number, five of which belong to the Canada Cement Company, Limited. These manufactured much the larger proportion of the output.

Herewith is a list of the Portland cement companies and plants of Ontario:—

Name of Company.	Location of Plant.
Canada Cement Company, Limited, Plant No. 4..	Belleville.
" " " " " No. 5..	Belleville.
" " " " " No. 6..	Marlbank.
" " " " " No. 7..	Lakefield.
" " " " " No. 8..	Port Colborne.
Hanover Portland Cement Co., Limited	Hanover.
Imperial Cement Company, Limited, The	Owen Sound.
Kirkfield Portland Cement Co., Ltd.	Raven Lake.
Maple Leaf Portland Cement Co., Ltd.	Atwood.
National Portland Cement Co., Ltd.	Durham.
Ontario Portland Cement Co., Ltd.	Blue Lake.
St. Mary's Portland Cement Co., Ltd.	St. Mary's.
Superior Portland Cement Co., Ltd., The	Orangeville.

The plant of the Sun Portland Cement Company, Owen Sound, has been closed. It did not operate last year.

Arsenic

From the silver-cobalt ores treated in Ontario refineries there was produced and shipped 3,927,347 pounds of white arsenic, which realized $79,297, or a little over two cents per pound. The theoretical percentage of arsenic in these ores is assumed to be 14.28, which; on the quantity of ore raised from Cobalt in 1912, would give 8,332,000 pounds of white arsenic. The difference between this quantity and the product actually marketed, must be set down for the greater part as waste. Little or no attempt to save the arsenic is made in the smelters of the United States to which much of the lower grade ore is shipped for treatment. The production of 1911 was 4,234,000 pounds, worth $74,609, the average value per pound being 1.76 cents per pound. Since the close of 1912 there has been a marked advance in the price of arsenic, which is chiefly a by-product of the ores of other metals. There are large deposits of arsenical ore in Hastings county, which at one time were worked for their gold contents, but which have remained untouched since experience showed the values to have fallen below the profit line.

Arsenic is a most useful substance in the arts, being employed as a preservative of skins, as a pigment, in the manufacture of glass for the purpose of imparting brilliancy, but chiefly as the active agent in insecticides. As a constituent of Paris green and arsenate of lead, it plays an important part in controlling the insect pests which annually work havoc amounting to tens of thousands of dollars among the potato fields and apple orchards of Ontario.

Iron Pyrites

No deposits of native sulphur, such as are found in Sicily and Louisiana, occur in this Province, yet there are very large supplies of sulphur locked up in the pyrrhotites of Sudbury and the iron pyrites of many other parts of Ontario's mineral regions. No attempt is being made, or in the present state of the metallurgical arts perhaps can be made, to recover the immense quantities of sulphur annually scattered to the winds in the fumes which ascend from the roast heaps of the nickel-copper companies of Sudbury. This sulphur is worse than wasted, because these acrid fumes blast and wither every green thing within their range, and when carried by contrary winds to centres of population are certainly objectionable. So long, however, as it costs more to entrap the surphur and convert it into sulphuric acid or some other article of commerce than the price it would bring when sold, this waste is inevitable.

Five deposits of pyrite were worked last year, but from three only were shipments made. These were the mines of the Canadian Sulphur Ore Company of Queensboro, in Hastings county; Nichols Chemical Company at Sulphide, and the Buffalo-Brockville Mining Company at Brockville. The output from the last-named was small, and work ceased about the middle of July. No shipments were made by the Northern Pyrites Company, from their mine on Big Vermilion lake, near Graham, nor from the Helen mine by the Algoma Steel Corporation. The quantity shipped was 20,744 tons, valued at $71,043. This was considerably less than the output for 1911, which was 43,629 tons, worth $118,457.

The Nichols Chemical Company operate an acid-making plant at Sulphide, at which is used not only the ore from the company's own mine at the same place, but also ore purchased from other deposits worked in the neighborhood. The ore from the Northern Pyrites and Helen mines when shipped goes to the United States for the manufacture of sulphuric acid, or for use in pulp and paper mills.

Following is a list of the iron pyrites mining companies in Ontario, working last year:—

Name of Company.	Location of Mine.
Algoma Steel Corporation, Limited	Helen Mine.
Buffalo-Brockville Mining Company	Brockville.
Canadian Sulphur Ore Company, Limited	Queensboro.
Nichols Chemical Company, Limited, The	Sulphide.
Northern Pyrites Company	Graham.

Mica

The amber mica of Ontario and Quebec has long been highly esteemed by manufacturers, especially those of electrical apparatus, for its flexibility and high insulating efficiency. Nevertheless, mica mining in Ontario shows comparatively little progress from year to year. Its product is meeting with strong competition in the markets of the United States from the white mica of India, where wages are low, and whose mica finds much favor from the form in which it is placed on the market, namely, in small circular boxes or cartons of mica films. These are used in building up the micanite or board mica in sheets of any desired size, which has practically taken the place of the large natural sheets formerly regarded as indispensable, and for which a high price was demanded. The irregular and pocketty nature of the mica deposits here, too, has a tendency to deter systematic exploitation or the expenditure of large sums in development.

Notwithstanding these drawbacks, the output of the mica mines of this Province for 1912 was considerably greater than for 1911, being 570 tons of rough-cobbed material, worth $57,384, as compared with 322 tons in 1911, valued at $43,058.

Following are the producers of mica, an asterisk signifying that no shipments were made in 1912:—

Company or Firm.	P. O. Address.	Location of Mine.
Allard, G. E.	Sydenham	Loughborough Tp.
Birch Lake Mining Syndicate	Ottawa	Loughborough Tp.
Brockville Mining Company	Brockville	South Crosby Tp.
*Connell, F. M.	Toronto	Lanark County.
Kent Bros. & J. M. Stoness	Kingston	Bedford Tp.
*Kingston Feldspar & Mining Company	Kingston	Loughborough Tp.
Loughborough Mining Co., Limited, The	Sydenham	Sydenham.
*McConnell, Rinaldo	Ottawa	North Burgess Tp.
McLaren, W. L.	Perth	North Burgess Tp.
*New York & Ontario Mining Co.	Perth Road	Loughborough Tp.
*Scriven & Whyte	Sydenham	do
*Tett & Brother, J. P.	Bedford Mills	do
*Trousdale, J. W.	Sydenham	Gould Lake.
*Watts, E., & Noble, John J.	Toronto	North Burgess Tp.

Salt

The production of salt from the wells situated on the eastern shore of Lake Huron and St. Clair and Rivers St. Clair and Detroit, remains at pretty much the same figure from year to year. In 1912 it amounted to 90,986 tons, valued at $450,251. The year previous the output was 88,689 tons, worth $430,835. Besides the ordinary uses of salt in the preservation of food products, a beginning has been made in its utilization as the raw material for a large and varied list of chemical manufactures. The Canadian Salt Company have begun the operation of a plant on the Detroit river, near the eastern boundary of the town of Windsor, having good railway connections and a shipping dock on the Detroit river channel bank. The products at present made are bleaching powder and caustic soda. The former is used for bleaching paper and fabrics and also for sterilization of water and sewage; the latter mainly in the manufacture of soap, also in the refining of certain grades of oil and glue, and in the manufacture of lye. It is proposed to add other products to the list. The market for the company's goods is found in Canada, the rate of duty preventing export to the United States. There is no protection on these articles in Canada. The number of hands employed last year was thirty-eight, and the wage bill amounted to $23,859.

Employees in the salt industry in 1912 numbered 219, who were paid in wages $151,218.

The Canadian Salt Company makes two-thirds of the entire output of salt in this Province, but there are a number of smaller independent plants also in operation. The process of manufacture is essentially the same in all; brine is pumped from the wells and evaporated. No rock salt is mined.

Following is a list of the salt-making companies; an asterisk denotes idleness for 1912:—

Name.	P. O. Address.	Location of Wells.
Canadian Salt Co., Limited	Windsor	Sandwich.
Canadian Salt Co., Limited	Windsor	Windsor.
Carter & Kittermaster	Mooretown	Mooretown.
Dominion Salt Co., Limited, The	Sarnia	Sarnia.
Elarton Salt Works Co., Limited, The	Hyde Park Corners.	Warwick Tp.
Exeter Salt Works Co., Limited	Exeter.	Exeter.
Gray, Young & Sparling Co., Limited, The	Wingham	Wingham.
Ontario People's Salt & Soda Co., Limited	Kincardine	Kincardine.
*Parkhill Salt Co.	Parkhill	Parkhill.
Ransford, John	Clinton	Stapleton.
Western Salt Co., Limited, The	Mooretown	Mooretown.
Western Canada Flour Mills Co., Limited	Goderich	Goderich.

Petroleum

A steady drying up of the sources which feed the petroleum wells of the Province has been in progress for a number of years. That the influences which cause this diminution are still in operation is manifest from the fact that the output of crude petroleum last year fell to 8,432,730 imperial gallons, or 240,935 barrels, as compared with 10,102,081 gallons, or 288,634 barrels in 1911, a reduction of 16.5 per cent. The production of 1912 was only 24 per cent. of that for 1904 when the yield was 34,912,360 gallons, or 997,496 barrels. A comparison of the production by districts in 1911 and 1912 is as follows:—

	1911.	1912.
	bbl.	bbl.
Lambton	184,450	150,272
Tilbury	48,707	44,727
Bothwell	35,244	34,486
Dutton	6,732	4,335
Onondaga	13,501	7,115
Total	288,634	240,935

These figures show that there has been a falling-off in all the fields, but at varying rates. Bothwell holds its own very well; the decline in Tilbury is not so rapid as a year or two ago; Dutton suffered a heavy loss and Onondaga—the youngest pool of all—went down to nearly one-half. Lambton (which includes Petrolea and Oil Springs), and Bothwell are evidently by no means on the verge of exhaustion, yet even in them there is a substantial decline. Drilling still goes on in quarters that may have possibilities of oil production, but no strikes of any consequence were made last year. The exact number of wells in operation is not known; the only way to ascertain it would be to enumerate them in the field. The average production probably does not exceed two barrels per month. Pumped as they are in groups of 20 to 60 on a single rig, the expense of operation is very small.

Mr. John Scott, Inspector of gas and oil wells, reports that 201 oil wells were abandoned during 1912. Of these 89 were in the township of Enniskillen, 36 in Tilbury, 25 in Sarnia, 19 in Moore, 18 in Raleigh, 6 in Caradoc, 5 in Mersea, and 3 in Plympton. Many others would also have been abandoned had it not been for the advance in the price of crude oil. Pumps have been removed from 625 wells not abandoned, and there are now about 600 wells being baled.

At the beginning of 1912 the price of petroleum averaged $1.24 per barrel, and at the close $1.62. The increases during the year were not at uniform intervals, but for statistical purposes, the value has been reckoned at the rate of $1.43 per barrel, or $344,537 for the whole. This does not include the Dominion Government bounty of 1½ cents per gallon, or 52½ cents per barrel.

The following table gives the production of crude petroleum by districts for the last five years:—

Table X.—Petroleum Production by Districts, 1908 to 1912

Field.	1908	1909	1910	1911	1912
	bbl.	bbl.	bbl.	bbl.	bbl.
Lambton	265,368	243,123	205,456	184,450	150,272
Tilbury and Romney	201,283	124,003	63,058	48,707	44,727
Bothwell	39,228	38,092	36,999	35,244	34,486
Leamington	9,334	5,929	141	....	....
Dutton	13,743	9,513	7,752	6,732	4,335
Onondaga (Brant Co.)	....	....	1,005	13,501	7,115
Total	528,959	420,660	314,410	288,634	240,935

The shortage in domestic crude and the increasing demands of the home market have naturally led to a large importation of petroleum by the refining companies, and the proportion of Ontario crude now distilled at their plants is a comparatively small proportion of the whole. In addition to imports of crude for refining purposes, large quantities of refined illuminating and lubricating oils, gasoline and other petroleum products have been brought in. Indeed, the situation now is such that if the production of crude petroleum in Ontario were to cease, the gap would be readily filled by increased imports from the United States, either of crude or the refined products themselves.

Following are the statistics of the refining industry for the five years 1908 to 1912 inclusive:—

Table XI.—Petroleum and Petroleum Products, 1908 to 1912

Schedule.		1908	1909	1910	1911	1912
Crude produced......	Imp. gal.	18.479.547	14,723.105	11.004.357	10,102.081	8,432,730
Crude distilled	"	34,675.120	35.530.918	36,171.032	38.632.504	46.270.701
Value crude produced	$	703.773	559,478	368,153	353.573	344.537
Value distilled products............	"	2,347,680	2.501.384	2,511.368	2.294.396	3.592,230
Illuminating oil....	Imp. gal.	17.604.920	17,902,254	18,983.357	20.240.523	23,090,280
Lubricating oil.....	"	3.384,940	3,856,778	4,469,038	4.729.257	5,932,166
Benzine and naphtha	"	3,667.997	3,930.691	4,297,615	4,179.575	4,955,022
Gas and fuel oils and tar..............	"	4,461.186	4,687.588	5.876.498	4.847.124	6.028,983
Paraffin wax and candles..........	lb.	5,400.003	7.092.278	5.179,391	5,267,485	8,086,841
Workmen employed ..	No.	430	436	428	511	699
Wages paid..........	$	247,829	261.014	280.485	314.851	436.852

Natural Gas

The natural gas fields of the Province last year yielded 12,414 million cubic feet of gas, which is valued in the returns made to the Bureau at an aggregate of $2,268,022, being at the rate of more than 18 cents per thousand cubic feet. In 1911 the output was valued at $2,186,762. The retail price of gas is on an average nearly double this figure, but the valuation is not based on the cost to the ultimate consumer, but on the price obtained by the producer, for the most part at the mouth of the well. Naturally, the users of gas in the towns and cities of southwestern Ontario must pay for the cost of piping and distribution, hence the price varies according to distance from the point of production, and other circumstances. As has been remarked before in these Reports, gas is a most desirable fuel, and it would be highly in the general interest if it could be confined to domestic purposes, and not expended on such operations as the burning of lime and brick, or for the generation of steam.

Gas in Lake Erie

No new fields or marked extensions of old ones were brought in during the year, but the productive area now occupies a large part of the northern and eastern shores of lake Erie. The eastern field, including the counties of Welland, Haldimand, Norfolk and Brant, is of greater extent, but Kent county yields nearly two-thirds of the entire production.

A somewhat novel departure is the boring for gas in the land under the waters of lake Erie adjoining the productive fields on the shore. This has been successfully done off the township of Rainham in the county of Norfolk, and wells are now being sunk in front of the townships of Tilbury East and Romney. The gas field in Essex county has ceased to yield, having been destroyed, as is generally believed, by the influx of salt water; but there are those who believe that gas is yet to be found in the extension of the old field under the lake in front of the townships of Gosfield South and Mersea, and who are desirous of being permitted to put down wells at some distance from the shore in order to test the correctness of this theory. It would appear from the situation of the old field on the land and from the fact that it broadens out as it approaches the lake, that the reservoir may extend under lake Erie, but no one can say in advance how far, if it exists at all, it has been affected by the conditions which injured the field on shore.

The Tax on Natural Gas

The Department maintains in the gas and oil fields of the Province, two Inspectors for the purpose of enforcing the provisions of the Act to prevent the waste of natural gas and to provide for the plugging of all abandoned wells. The Inspectors are Mr. John Scott, Petrolea, and Mr. Donald Sharpe, Welland. The former's duties are exercised in the counties of Lambton, Essex, Kent and Elgin, and the latter's in the Welland-Haldimand-Norfolk-Brant field. There are also certain provisions in the Supplementary Revenue Act, 1907,—which imposes a tax on natural gas—designed to make illegal the wilful and deliberate waste of natural gas which is so common in gas districts. Under the latter Act a tax of two cents per thousand cubic feet is leviable on all natural gas produced in the Province, but a rebate of 90 per cent. is allowed on all gas used in Ontario. The enforcement of these laws has had two results: (1) No gas is now piped out of the Province for consumption in the border cities of the United States, and (2) the waste of gas has been reduced to a minimum. The fact that in any given field the gas comes from a reservoir common to all the wells, gives each producer an incentive to see that no one wastes any part of the product, for what is permitted to escape without performing some useful office diminishes by just so much the stock of all. The efforts of Mr. G. R. Mickle, Mine Assessor, and of Inspectors Scott and Sharpe, to enforce the regulations against waste of gas have met with general support from gas producers, and have brought the controllable waste of gas to a minimum. The chief, if not the only, point of difficulty is where oil and gas are found in the same well. In such a case the law authorizes the owner to allow the gas to escape; but, fortunately, those portions of the gas territory where oil is also found in commercial quantity do not constitute a large part of the whole.

Mr. Mickle furnishes the following notes regarding the natural gas industry:—

Natural Gas Industry in 1912

Natural gas was obtained from three different fields or areas during the year, viz.: the oldest or the Welland-Haldimand-Norfolk-Brant field, which commences near the Niagara river and stretches westward along lake Erie for about seventy miles with some barren places. The next historically is the Kent field, which was fully described in Vol. XIX, p. 149-153, Report of the Bureau of Mines, and which appeared as a producer first in 1907. The third is the Elgin field, in the township of Bayham, described in Vol. XX, p. 49 of the Bureau's Reports, and producing first in 1911.

The total production from these three fields was approximately 12,454.9 million cubic feet, distributed as follows:—

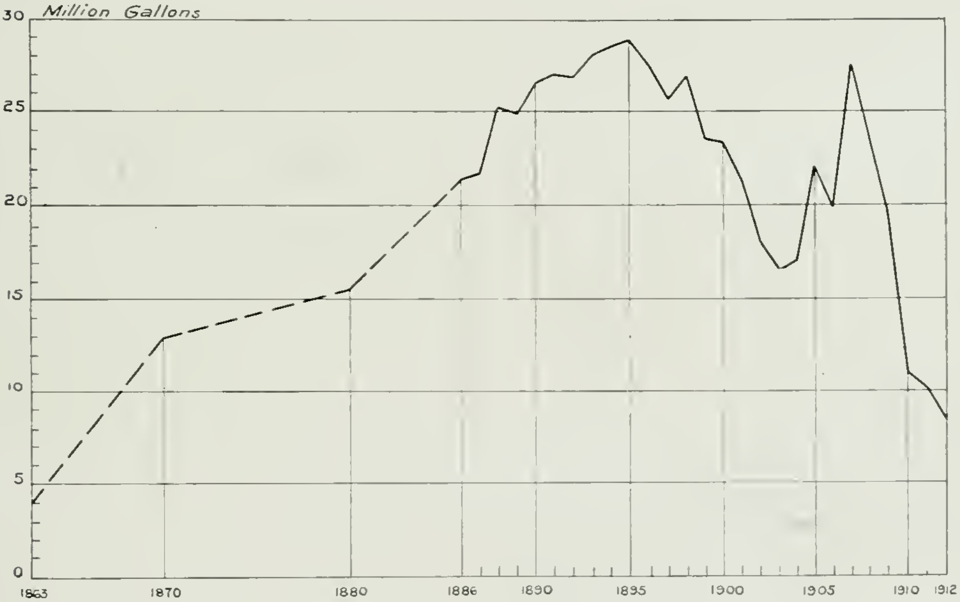
	Million Cu. Ft.		
Welland-Haldimand-Norfolk, etc.	4,246.0	or	34.0%
Kent	7,752.5	"	62.2%
Elgin	456.4	"	3.8%
Total	12,454.9	"	100.

The gas-bearing rock in the Welland-Haldimand, etc., area does not usually extend more than a very few miles back from lake Erie; probably the total area on the land covered by this gas rock is about 200 square miles. This field has been producing gas for over twenty years. It is impossible to give statistics of the total production from the field up to the present, as during the earlier years no complete record was kept of the output. It seems probable, however, that an approximate estimate can be made The writer proposes to attempt this at some future ime. During the seven years covered by the Supplementary Revenue Act, the total yield from this field has been approximately

25,891 million cubic feet. The drain has been very heavy, and in the older parts the productive period is drawing to an end. No oil has been found associated with the gas in this field.

Separated from this first-mentioned area by a barren or untested stretch of about twelve miles, is the small Elgin field mentioned above, in which the sand-bearing rock so far known at present, is found within an area of less than ten square miles, reckoning the dry land only. Undoubtedly, however, in all three fields the gas-bearing rock extends some distance under lake Erie. Up to the end of 1912 the production from this part has been 582 million feet. The prospects that this will develop into a very important field seem small. The area is not great and the gas-bearing strata are thin.

The Kent field, as is seen above, was much the heaviest producer, and appears as if it would ultimately yield more gas than the first-mentioned one. It is separated from the Elgin field by an interval of about sixty miles which is barren or untested. As the gas is found in different rock and differs in composition from that obtained in Elgin, it is undoubtedly not connected with the latter in any way. The total yield of gas up to the end of 1912 from this field, including waste in the first years after discovery as explained on p. 39, Vol. XXI, Report of the Bureau of Mines, is 23,132 million cubic feet. The land area is about twenty-six square miles.



Production of crude oil in Ontario up to the end of 1912 (from 1863 to 1886 estimate only).

Equivalent of Gas in Oil

It is customary in dealing with the natural gas industry to value it according to the price at which the gas is sold; as it permeates certain strata of rock, and the amount drawn off is not confined to the holdings of any lessee, but comes in part from the adjoining lands, intense competition arises among gas operators, and a desire to draw off as much gas as possible before their rivals. Hence a great part of the gas is sold for extremely low prices—10 to 15 cents per thousand to the consumer—and a proper idea is not obtained of its value. Practically all gas and oil are converted into heat when used. If they are employed as illuminants, some substance is heated and radiates the light. In the case of oil giving light from the flame direct, the particles of carbon are heated and act as radiators of light. In order, therefore, to compare oil and gas, both must be reduced to their equivalent heat units. As shown on p. 152 of the 19th Report, a barrel of oil (35 gal.) is equivalent to about 5,400 cubic feet of natural gas of the kind found in Kent; hence the amount given above is equivalent to about 4,283,600 barrels of oil. If this is compared with the total production of oil in the Province up to the end of 1912, a better idea can be had of the value of the Kent gas field.

Complete returns of the oil production do not exist, as far as the writer can ascertain, but Vol. V of the Bureau's Reports gives the production from 1886 up to 1891 (p. 21), and from that onwards the annual reports give the statistics. The total amounts to 591,600,000 gals. approximately. For the period preceding this, beginning with 1862, when the production started, only an estimate can be made. The Geological Survey Report, 1863 (p. 786), gives the production for seven months in that year, and the calculated amount for the year in the same proportion is approximately 3,860,000 gals. The Report of the Royal Commission on the Mineral Resources of Ontario, 1890 (p. 209), states that the production in 1870 was 12,900,000 gals., and for 1880, 15,500,000 gals. These returns were made in connection with the decennial census. By plotting these known points to scale as shown on accompanying chart and joining the points mentioned, the probable production for each year can be ascertained. If this is done it will be seen that it amounts to 302,500,000 gals. for 1863 to 1886, or a total probable production up to the present of oil from the whole Province of 894,100,000 gals. or about 25,540,000 barrels.

As is seen, the Kent gas field has produced already the equivalent of one-sixth of this, and certainly will produce more than six times the amount yielded up to the present, and therefore, in actual value to the consumer will exceed the value of the yield of oil from the whole Province. When it is considered that this very valuable asset was very nearly sacrificed in the elusive search for oil, which in the end was insignificant in amount—less than 10,000 barrels from the gas field proper—the need for stringent legislation to prevent any possibility of the recurrence of a similar state of affairs is apparent.

Inspector Sharpe reports that during the year two new gas fields were found in the county of Haldimand, one being in the township of Sherbrooke and the other in the township of Dunn, on the east and west sides respectively of the mouth of the Grand river. These fields are within five miles of the first wells drilled in the county of Haldimand. The wells are the most productive of any in the county, six of them yielding over a million cubic feet each per day. Two other fields have been developed, one in Canboro', Haldimand county, and the other in Binbrook, county of Welland. Drilling is in progress near Woodstock, and if successful, the gas will be piped to that city. Three deep wells, 2,800 feet each, were drilled in Haldimand, at Jarvis, Nelles' Corners and York respectively, but all three were practically dry. Considerable drilling is in prospect for 1913. The largest single producer is the Dominion Natural Gas Company, which drilled 63 wells during the year and have a total of 343 producing wells. A large syndicate under the name of H. L. Doherty & Co., of Broadway, New York, have obtained a charter from the Dominion Government for a company capitalized at $12,000,000 with the object of taking over all natural and artificial gas companies recently acquired by the syndicate.

There were in all the fields at the close of 1912 1,247 producing wells, of which 178 had been put down during the year. The number of non-producing wells bored in the year was 41. There were 1,448 miles of pipe, the number of employees engaged in the business was 277, and the wages paid them amounted to $184,351.

The following list gives the names and addresses of owners or operators of gas wells having any considerable production last year:—

Name.	P. O. Address.
Aikens, Smith and Lalor	Dunnville.
Aldrich Gas and Oil Company	Selkirk.
Aikens and Kohler	Dunnville.
Bertie Natural Gas Company, Limited	Ridgeway.
Beck, Aikens and Lalor	South Cayuga.
Beaver Oil and Gas Company, Limited	Brantford.
Bertie Natural Gas Company, Limited	Ridgeway.
Chippewa Oil and Gas Company, Limited	Tavistock.
Cheapside Natural Gas and Oil Company	Cheapside.
Canboro' Natural Gas Company, Limited	Canboro'.
Canadian Gas Company, Limited	Detroit, Mich.
Canadian Steel Foundries	Port Robinson.
Canfield Natural Gas Company, Limited	Canfield.
Coleman, J. A.	Wellandport.
Crystal City Oil and Gas Company, Limited	Brantford.

Name.	P. O. Address.
Commonwealth Gas Company, Limited	Hamilton.
Dominion Natural Gas Company, Limited	Pittsburg, Pa.
Dunn Natural Gas Company	Dunnville.
Deagle, John	Tuscarora.
Danskin, David	Cainsville.
Empire Limestone Company	Buffalo, N.Y.
Enterprise Gas Company, Limited, The	Delhi.
Fisherville Gas Company	Fisherville.
Holmes Gas Company	Selkirk.
Humberstone Mutual Natural Gas and Fuel Company, Limited	Humberstone.
Hagersville Light and Fuel Company, Limited	Hagersville.
Hamilton, Alex.	Onondaga.
Howell, H.	Onondaga.
Hager, Ham.	Tuscarora.
Home Natural Gas Company, Limited	Hamilton.
Hoover, Jas. E.	Selkirk.
Hoover, D. E., A. E., and Menno	Rainham Centre.
Hoover, D. E.	Rainham Centre.
Industrial Natural Gas Company, Limited	Port Robinson.
Kohler Gas Company	Kohler.
Kindy and Sons, D.	Selkirk.
Lamb, Walter B.	Nanticoke.
Lalor, F. R.	Dunnville.
Lawson, J. J.	Stromness.
Lint and Emerson	Attercliffe.
Lamb, Alfred	Selkirk.
Maple City Oil and Gas Company, Limited	Chatham.
Medina Natural Gas Company, Limited	Chatham.
Miller, R. F.	Rainham Centre.
Midfield Natural Gas Company, Limited, The	Hamilton.
Marshall, James	Hamilton.
Manufacturers' Natural Gas Company	Hamilton.
Melick and Moote	Dunnville.
Norfolk Gas Company, Limited	Port Dover.
North Shore Gas Company, Limited	Hamilton.
Northwestern Gas Company, Limited	Erie, Pa.
Oxford Oil and Gas Company	Brantford.
Onondaga Oil and Gas Company, Limited	Brantford.
Ontario Iron and Steel Company, Limited	Welland.
Port Rowan Natural Gas Company, Limited	Pittsburg, Pa.
Port Maitland Gas Company	Port Maitland.
Provincial Natural Gas and Fuel Company, Limited	Niagara Falls, Ont.
Producers Natural Gas Company, Limited	Hamilton.
Port Colborne-Welland Natural Gas and Oil Company, Limited	Port Colborne.
Rolston and Bennett	Dunnville.
Regah Gas Company	Hagersville.
South Cayuga Natural Gas Company	South Cayuga.
Snively, F. L.	Dunnville.
Sterling Gas Company	Port Colborne.
Selkirk Gas and Oil Company, Limited	Selkirk.
Steele, J. A., Estate of	Humberstone.
Springvale Natural Gas Company	Springvale.
Standard Natural Gas Company, Limited	Dunnville.
Telephone City Oil and Gas Company, Limited	Brantford.
Union Natural Gas Company, Limited	Niagara Falls.
United Gas Companies, Limited	St. Catharines.
Utor Gas Company, Limited	Rainham Centre.
Van Sickle, A. W.	Onondaga.
Waines and Root Gas Company, Limited, The	Dunnville.
Welland County Lime Works, Limited	Port Colborne.
Widrick, M.	Nanticoke.

Miscellaneous

There was about the usual production of mineral substances, most of them non-metallic, not referred to above. They include calcium carbide, corundum, feldspar, graphite, gypsum, quartz and talc. All of these except calcium carbide and gypsum are obtained from Eastern Ontario, and almost all occur in quantities which would permit a much larger output, if the demand existed.

Gypsum

The gypsum deposits of the Province now being worked are in the valley of the Grand river, principally in the neighbourhood of Caledonia. Some of them have been operated for many years, and the workings are now quite extensive. Occurring as horizontal beds, with a thick over-burden, the gypsum bodies are mined like coal. The development of the Portland cement industry has furnished a new outlet for gypsum, a small proportion of which is added for the purpose of regulating the setting of the cement. Large deposits of gypsum are known to occur in the valleys of several rivers running down the northern slope into James Bay, but as yet they are too remote from transportation facilities to be available. The production of crude material in 1912 amounted to 31,331 tons, valued at $50,246. Besides its use as a "retarder" in cement, gypsum is manufactured into alabastine and other forms of wall dressing, wall plaster, etc.; it is also employed in the ground form as a carrier of poison for potato bugs, and as a fertilizer.

Calcium Carbide

The manufacture of calcium carbide in Ontario is now confined to the Canada Carbide Company, whose works are situated at Merritton. Calcium carbide is formed by fusing lime and carbon in the electric furnace, and when subjected to the action of water, gives off acetylene gas, a powerful illuminant, now largely used where ordinary gas or electric light is not available, as in small or isolated places. Some 1,998 tons were made in 1912, valued at $120,000, or $60 per ton.

Corundum

Corundum is obtained from the deposits in Renfrew and Hastings counties, the rock in which they occur being mainly nepheline syenite. The working of these deposits has shown that as a rule the crystals of corundum which are found on the surface do not continue to great depth, hence they are worked by open cut or quarry methods. Operations began in 1899, and for a time were carried on by two concerns, known at first as the Canada Corundum and Ashland Emery and Corundum Companies. The interests of both were subsequently acquired by the Manufacturers' Corundum Company, which continued to mine and treat the corundum by crushing and grading it until last year. Recently, however, the mill was burned down. In 1912 the output of grain corundum was 1,960 tons, of a value of $233,212, or $119 per ton. The chief use of corundum is as an abrasive or polishing material for metals. For certain classes of work it is preferred to anything else, but various artificial compounds are now being produced which compete with corundum in certain lines of manufacture. Among these is carborundum, the silicide of carbon, made by fusing silica and carbon in the electric arc. Corundum is pure alumina, but so far has defied experimenters who have endeavoured to dissociate the oxygen from the aluminium, and obtain the latter in metallic form.

Feldspar

Feldspar is a common rock constituent, and makes up a large part of the granite and gneisses of eastern and northern Ontario. Occasionally it is found in masses sufficiently pure to admit of its being quarried and used in the manufacture of pottery, enamelled ware and kindred articles. The principal feldspar quarries are on the line of the Kingston and Pembroke railway, near Verona, but the mineral also occurs in the neighbourhood of Parry Sound and elsewhere. It is mostly exported to East Liverpool, Ohio, and Newark, New Jersey, for the use of the pottery trade there. The Verona deposits are of the microcline variety, and contain 13 or 14 per cent. of potash. The demand for the latter substance to maintain or replenish the fertility of the farms of the United States and Canada has given rise to many attempts to obtain the potash ingredient of feldspar in a form which could be laid hold of by vegetation, but so far no successful method seems to have been perfected. In 1912 the output of feldspar was less than usual, being 13,633 tons, valued at $28,916, as compared with 17,697 tons in 1911, worth $51,610. Dominion Feldspar, Limited, formerly the Suroff Feldspar Mining and Milling Company has built and equipped a mill for grinding feldspar at Parham. It was nearly ready for operation at the end of 1912. The bulk of the production was by the Kingston Feldspar and Mining Company, which operated its quarries at Desert lake, Bedford township, and Reynolds' mine, Portland township. The McDonald Feldspar Company, Charles Jenkins, and Ojaipee Silica and Feldspar Company, did not operate during the year.

Graphite

Refined graphite to the amount of 1,246 tons was produced last year, valued at $65,076. Two plants were in operation, namely, those of the Black Donald Graphite Company, at Whitefish lake, in the county of Renfrew, and the Virginia Graphite Company at Wilberforce. The New York Graphite Company began the construction of a mill for treating graphite at Harcourt last year. The Globe Refining Company's plant at Port Elmsley was idle during the whole of 1912. The chief use of graphite is in the manufacture of crucibles, lead pencils, foundry facings, stove polish, etc. It is also employed as a lubricant for gear and sprocket wheels. Artificial graphite made in electric furnaces from carbon has come extensively into use during the last few years.

Quartz

Most of the quartz taken out last year was raised by the Canadian Copper Company at their quarries in the township of Dill, being required for lining the furnaces used in converting low grade matte into Bessemer matte. The Kingston Feldspar and Mining Company annually obtain a quantity of quartz while working their feldspar deposits, the quartz occurring as veins or dikes cutting the spar. Messrs. Willmott and Company operated a quartz quarry near Killarney, and the McPhail and Wright Construction Company another on the line of the Algoma Central and Hudson Bay railway. Part of the quartz output is used in the manufacture of ferro-silicon by Electro Metals Limited, at Welland.

Talc

Talc is mined at Madoc and Eldorado in Hastings county, and is ground at the former place by Messrs. Geo. H. Gillespie and Company, and at the latter by the Canadian Talc and Silica Company, Limited. In all 13,446 tons of crude talc were raised during 1912, and of the ground product 6,726 tons were shipped, valued at $61,358. At the mines and mills, 79 hands were employed, earning wages amounting to $32,396. The chief use to which ground talc is put is in the manufacture of paper; it is also utilized as a cosmetic and in soap-making.

Peat Fuel

The manufacture of peat fuel has not developed as rapidly as was at one time hoped. There is no lack of the raw material, and there is a practically unlimited market, but there are difficulties in the way of steady and economical production which do not appear to have been satisfactorily overcome by any of the processes hitherto put forward. The chief difficulty lies in getting rid of the moisture. It seems that the application of any form of artificial heat adds too much to the cost, while if the sun and wind are depended upon to eliminate the water, a wet summer, such as that of 1912, practically renders the manufacture impossible. At two points in Ontario peat fuel was made last year, namely, at Alfred by Mr. J. M. Shuttleworth, and at North Dorchester by Dr. J. McWilliam. The combined shipments amounted to 175 tons, valued at $725.

Mining Revenue

From the several sources of mining revenue the Government received during the fiscal year ending 31st October, 1912, the sum of $633,778.95, being a falling-off as compared with the previous twelve months, of $165,141.06. Itemized statements for the two years are as follows:—

Service.	12 months ending 31st Oct., 1911	12 months ending 31st Oct., 1912
Sales of mining land	$64,268.43	$51,634.48
Rental leases do.	25,797.14	33,098.34
Miners' licenses, permits and fees	211,768.57	107,162.70
Mining royalties	285,913.26	250,145.65
Supplementary Revenue Act, 1907	209,461.51	190,875.53
Provincial Assay Office	1,362.37	654.00
Diamond drills	......	208.25
Provincial mine	348.73	......
Total	$798,920.01	$633,778.95

It will be observed that receipts from sales of mining land have decreased while revenue from rentals is greater. This is in part due to the fact that much of the activity in taking up lands for mining purposes was displayed within the limits of the Temagami Forest Reserve, where the law does not permit such land to be sold outright, but authorizes leases only. In the following table is given particulars of the land disposed of by the Crown under the provisions of the Mining Act. As will be seen, the total receipts as shown by this table do not agree with those given above. The discrepancy is due to the fact that the sums appearing in the first table are those actually received within the fiscal year, while in the second are given only those pertaining to the transactions consummated—patents issued, leases made, etc.—during the year.

Table XII.—Mining Lands Sold and Leased for year ending October 31st, 1912

District.	Sales.			Leases.			Total.		
	No.	Acres.	Amount.	No.	Acres.	Amount.	No.	Acres.	Amount.
			$			$			$
Nipissing	265	10,726.95	24,697.83	434	16,032.55	16,637.35	699	26,759.50	41,335 18
Sudbury	101	4,002.29	10,923.98	8	280.70	280.70	109	4,282.99	11,204.68
Algoma	21	1,282.18	3,244.78				21	1,282.18	3,244.78
Thunder Bay	54	2,455.10	5,694.75				54	2,455.10	5,694.75
Kenora	13	495.70	1,155.25				13	495.70	1,155.25
Elsewhere	8	370.74	919.01	11	398.60	398.60	19	769.34	1,317.61
Total	462	19,332.96	46,635.60	453	16,711.85	17,316.65	915	36,044.81	63,952.25

License and Recording Fees

The amount received for miner's licenses, permits to search for minerals in forest reserves, and recording fees, was considerably less than in the previous fiscal year, the decrease being $104,605.87. The items are as follows:—

Miner's Licenses	$56,147.75
Forest Reserve Permits	1,780.75
Recording Fees	49,234.20
Total	$107,162.70

Receipts under the foregoing headings are essentially dependent upon the amount of prospecting and staking out of mining claims during the year. When rich discoveries are made and new mineral belts of promise opened up, there is a rush to take up claims. No one can stake or record a claim who is not the holder of a miner's license, the charge for which is five dollars, nor can an unpatented claim be transferred to any one not a licensee. For recording a claim the fee is ten dollars, for registering a transfer two dollars, etc. The falling off in the fees paid in through the Mining Recorders' offices suggests that there were fewer prospectors in the woods and fewer claims recorded or transferred last year than in the previous one; and such was the case. Cobalt, South Lorrain, Gowganda and Porcupine have all been pretty thoroughly gone over, at any rate according to the estimate of the majority of prospectors; and there is at present a period of comparative quiescence. Past experience, however, leads to the opinion that this phase is temporary. New discoveries are bound to be made, and they will lead to fresh outbursts of prospecting and recording. The staking in Teck and Lebel, which followed on the finding of the rich, if small, gold-bearing veins at Kirkland lake, is evidence, if any is needed, that a watchful eye is maintained by the prospecting fraternity upon promising developments in northern Ontario.

Royalties

The mining royalties collected during the year amounted to $250,145.65, as follows:—

O'Brien mine	$72,070.81
Crown Reserve Mining Company	136,179.90
Hudson Bay Mines	36,758.88
Wyandoh Mining Company	123.58
Cobalt Provincial Mines	5,012.48
Total	$250,145.65

The aggregate royalties by the various mines subject to the same, up to 31st October, 1912, are as follows:—

O'Brien mine	$668,376.51
Crown Reserve Mining Company	611,990.91
Hudson Bay Mines	245,270.32
Chambers-Ferland Mining Company	26,259.64
Hargrave Silver Mines	1,200.00
Waldman Silver Cobalt Mining Company	777.48
Wyandoh Mining Company	1,421.72
Cobalt Provincial Mines	6,735.14
Total	$1,562,031.72

Certain changes were made during the year in the rate of royalty paid by some of the companies. These were as follows:—

(1) The rate payable by the O'Brien mine was reduced from 25 per cent. on the gross value of the ore at the pit's mouth (less surface costs) to 15 per cent. of the net profits as ascertained on the basis of the Supplementary Revenue Act, 1907. Should other bonanzas be struck in future workings the Government retains the power to restore the former rate.

(2) In the case of the Chambers-Ferland and Hargrave companies the royalty, which was originally the same as was levied on the O'Brien mine, has been abolished entirely; but the right is reserved should rich ore be encountered in quantity, to impose a rate not exceeding 15 per cent. of the net profits on the Supplementary Revenue Act basis, after allowing for a dividend to the shareholders up to 10 per cent. per annum.

In general it may be said that the reason for making these concessions was the allegation, which investigation proved to be correct, that the condition of the properties was now such as would not warrant a heavier burden, and that if the former royalties were to remain in force, the period was at hand when the mines would have to cease working altogether.

Supplementary Revenue Act, 1907

The operation of the Supplementary Revenue Act, 1907, yielded for the calendar year a total of $190,875.53, made up as follows:—

Profit Tax	$155,506.86
Acreage Tax	15,770.62
Gas Tax	19,598.05
Total	$190,875.53

The Act provides for the appointment of an officer called the Mine Assessor, to collect the revenue arising under it, and Mr. G. R. Mickle, M.E., formerly professor of mining engineering at the School of Practical Science, Toronto, has occupied the position from the time the act came into force six years ago. Under Mr. Mickle's supervision the Act has worked smoothly, and there has been a generous measure of co-operation on the part of the mining companies in putting its provisions into effect. Mr. Mickle furnishes the following information regarding the working of the Act during the year 1912. It should be pointed out that his figures of revenue are for the calendar year, while those given above are for the twelve months ending 31st October, the date at which the fiscal year for the Province closes.

There are three different kinds of tax levied under this Act, viz.: (1) Profit tax, which is at the rate of three per cent. on profits of mines in excess of $10,000, with certain deductions for taxes paid municipalities. (2) Natural gas tax, at the rate of two-tenths of a cent per thousand cubic feet. (3) Acreage tax, of two cents per acre on all mining lands in territory with no municipal organization.

The amount collected under this Act belonging to the calendar year 1912 was $210,407.32, and was distributed as follows:—

Profit Tax	$176,527.24
Natural Gas Tax	19,440.36
Acreage Tax (15th Ap., 1912, to 15th Ap., 1913)	14,439.72
Total	$210,407.32

This is about 28 per cent. more than the amount collected in 1911. The chief increase was in the profit tax, due mainly to the heavy production in 1911 in the Cobalt district, the tax being based on the results of the preceding year. As the fiscal year for the Province ends on the 31st of October and the tax is not due till October, a certain amount is always paid in the next fiscal year and this statement will not agree with the public accounts.

The profit tax was paid by fourteen different companies, the greater part coming from the silver mines of Cobalt. No revenue was obtained from gold mines in 1912. A substantial amount will probably be derived from the operations of gold mines in the coming years. As certain companies in the Cobalt district paying a royalty to the Crown may under their agreements deduct any tax paid from the royalty, the tax is not collected from these. If it had been, the tax would be about $42,000 more and the royalties, of course, less by the same amount. For several years the aggregate amount paid as profit tax by all the mines of the Province should not be very materially altered.

The natural gas tax was obtained from forty-eight different companies or individuals, some of the amounts being quite small. Twenty-seven of those contributing paid less than $100 each. This tax is about 10 per cent. more than last year, with an apparent increase in sight for the next few years, and then a decline, unless new fields are found.

In the case of the acreage tax no attempt is made to keep the tax for the different years separate. No bills are sent for this tax, and payments are made throughout the entire year. In many cases the owners pay several years' taxes at one time. The amount given above includes penalties and costs of advertising.

The operation of the acreage tax is a matter of some interest in 1912, as the second list of lands two years in arrears of taxes was advertised in accordance with the Act, and the provisions may now be considered to be in normal working order. One great difficulty has been met in carrying out these provisions of the Act, due to the non-enforcement of the Algoma Land Tax Act, which was passed in 1868, and which covered fully five-sevenths of the lands liable under the Supplementary Revenue Act. By two amendments to the former Act owners of lands were directly encouraged not to pay the tax, viz.: in 1886 (49 Vic. Chap. V., Sec. 5), whereby the tax which was originally 2 cents per acre, was changed to one cent, and a discount of 50 per cent. allowed on all arrears; also in 1903 (3 Edw. VII., Chap. 2, Sec. 2), whereby lands which had been brought into any municipality were relieved of all arrears of Provincial taxes.

The total number of parcels of land on the tax roll was 7,109 at the end of 1912. Of these, 285, or about 4 per cent. were advertised as two years in arrears, and before the time for making payment had elapsed—six months being required by the statute —over half the number were placed in good standing again, leaving 128 parcels, or about 1.8 per cent. of the total to be forfeited. This insignificant proportion of the whole, which the owners have decided to abandon, is an index of the interest felt in the mineral lands of the Province. There was no substantial difference in the percentage forfeitable in the several districts outside of Parry Sound, which contains only 2 per cent. of the total number of parcels and showed 6 per cent. forfeitable. The proportions in the other districts varied between 3 and 0.6 per cent.

Mining Companies

The business of forming joint stock companies for the exploitation of mining prospects and the working of mines, fell off very considerably last year, the ratio between the number of such incorporations and the intensity of the speculative fever being very definite. Speculation in mines and mining stocks for the time being gave way to speculation in real estate, and there being a poor market for mushroom shares, a much smaller number was offered. The number of mining companies incorporated under the laws of Ontario was one hundred and thirty, with an aggregate authorized capital of $73,237,000, as against two hundred and thirteen in 1911, with a capitalization of $215,640,000. Thus, while in number the incorporations were fewer by over one-third, the gross amount of nominal capital stock was smaller by nearly two-thirds, compared with the record for the previous year. Moreover, gold and silver mining companies no longer predominate. More companies were incorporated in 1912 for making brick than for mining gold, and almost as many for obtaining natural gas and oil as for winning silver. Stone, marble, and trap rock for roadmaking purposes called more than a dozen into existence, and industrial operations concerned with other metals and minerals were responsible for the remainder.

In addition to the companies of domestic origin, six foreign corporations were licensed to do business in Ontario, having an aggregate capital of $570,000.

Following is the list:—

Mining Companies Incorporated in 1912

Name of Company.	Head Office.	Date of Incorporation.	Capital.
A. B. P. Mining Company, Limited	Toronto	April 12	$40,000
Aladdin Cobalt Company, Limited	Toronto	August 23	500,000
American Eagle Mining Company, Limited	S. ½ Lot 10 in 1 Tp. of Munro.	March 2	40,000
Anchorite Mining Company, Limited	Toronto	July 22	250,000
Augarita Mines, Limited	Toronto	January 11	2,000,000
Beachville White Lime Company, Limited	Beachville	July 18	40,000
Beaver Auxiliary Mines, Limited	Toronto	September 10.	500,000
Bishopric Wall-Board Company, Limited	Ottawa	August 23	150,000
Brandon's Oil and Gas Company, Limited	Milton	April 16	100,000
Buffalo and Dunnville Oil and Gas Company, Limited	Dunnville	September 20.	100,000
Buffalo Corundum Company, Limited	Fort Erie	January 26	40,000
Buffalo-Ontario Lead Company, Limited	Kingston	May 20	100,000
Buffalo-Ontario Smelting and Refining Company, Limited	Toronto	February 16	40,000
Canada Amalgamated Nickel and Copper Company, Limited	Toronto	March 15	2,000,000
Canada Crushed Stone Corporation, Limited	Hamilton	December 11	1,500,000
Canada Veteran Gold Mines, Limited	Toronto	March 25	1,000,000
Canadian Finance and Securities, Limited	Toronto	March 1	50,000
Canadian Furnace Company, Limited	Port Colborne	March 18	500,000

Mining Companies Incorporated in 1912—Continued

Name of Company.	Head Office.	Date of Incorporation.	Capital.
Canadian Gas Company, Limited	Windsor	January 18	1,000,000
Canadian Marble Company, Limited	Toronto	May 20	100,000
Canadian Mining and Exploration Company, Limited	Toronto	May 18	5,000,000
Canadian Quarries, Limited	Hamilton	December 5	100,000
Cartwright Gold Fields, Limited	Toronto	January 8	1,000,000
Casey Kismet Mining Company, Limited	Toronto	March 28	40,000
Consolidated Ophir Mines, Limited	Toronto	January 2	5,000,000
Dane Mining Company, Limited	Haileybury	February 14	500,000
Deer Lake Gold and Silver Mines, Limited	North Bay	June 18	500,000
Dome Lake Company, Limited	Toronto	September 17	500,000
Dominion Reduction Company, Limited	Toronto	June 27	400,000
Elizabeth Gold Mines, Limited	Toronto	January 11	500,000
Elk Fire Brick Company of Canada, Limited	Hamilton	December 18	40,000
Elk Lake Holding Company, Limited	Toronto	October 2	40,000
Fleur-de-Lis Silver Mining Company, Limited	North Bay	September 19	1,500,000
Fraser-Bay Iron Company, Limited	Sault Ste. Marie	October 9	1,000,000
Gem Flint Iron Company, Limited	Sarnia	February 15	100,000
General Mines, Limited	Toronto	September 10	1,000,000
General Natural Gas and Oil Company, Limited	Windsor	March 22	100,000
Glenwood Natural Gas Company, Limited	Toronto	December 31	750,000
Gold Eagle Mines, Limited	Haileybury	January 22	1,000,000
Gordon Porcupine Mines, Limited	Toronto	March 13	40,000
Hart Porcupine Mines, Limited	Toronto	March 13	40,000
Hayden Gold Mines, Limited	Toronto	September 7	2,000,000
Huron Trap Rock Company, Limited	Sault Ste. Marie	December 20	100,000
Huronian Exploration Company, Limited	New Liskeard	January 27	50,000
Kenroy Gold Mines, Limited	Toronto	February 21	1,000,000
Lorraine-Trout Lake Mines, Limited	Toronto	October 16	1,800,000
Martin International Trap Rock Company, Limited	Bruce Mines	December 7	600,000
Meaford Brick Company, Limited	Toronto	May 7	500,000
Medina Shale Brick Company, Limited	Toronto	November 18	180,000
Melbourne, Limited	Toronto	May 13	100,000
National Sand and Material Company, Limited	Welland	April 20	40,000
New York Graphite Company, Limited	Toronto	August 23	1,000,000
Niagara Natural Gas and Fuel Company, Limited	Sherkstone	May 9	40,000
Northern Canada Prospecting Company, Limited	Toronto	April 22	40,000
Northern Quarries, Limited	Toronto	November 19	50,000
Ontario Calvert Porcupine Mining and Reduction Co, Ltd	Toronto	March 4	40,000
Ontario Solid Silver Mines Limited	Toronto	October 2	100,000
Penn-Canadian Mines, Limited	Toronto	April 24	1,500,000
Peoples' Proprietary Mines Company, Limited	Toronto	April 25	250,000
Peterboro' Oil and Gas Company, Limited	Peterborough	August 10	40,000
Porcupine Fortuna Gold Mines, Limited	Toronto	January 4	2,000,000
Porcupine Gold Leaf Mining Company, Limited	Toronto	March 25	1,000,000
Porcupine Golden Quill Mining Company, Limited	Toronto	February 26	1,500,000
Porcupine Krist Mines, Limited	Toronto	March 12	1,500,000
Porcupine Twin Mining Company, Limited	Toronto	February 12	1,950,000
Prices, Limited	Toronto	March 1	100,000
Quaker City-Porcupine Mines, Limited	Toronto	April 2	2,000,000
Rochester Mines, Limited	Toronto	September 27	1,000,000
Saratoga-Syracuse Mining Company, Limited	Toronto	March 5	1,000,000
Shale Products, Limited	Inglewood	May 1	150,000
Silver Islet Mining Company, Limited	Fort William	July 20	500,000
Six Nations Mining Company, Limited	Toronto	July 30	1,000,000
Soo Trap Rock Company, Limited	Sault Ste. Marie	March 11	50,000
South Bay Mines of Gowganda, Limited	Toronto	February 22	40,000
Standard Development Company, Limited	Bowmanville	July 5	100,000
Superior Brick Company, Limited	Fort William	October 3	500,000
The Algunican Development Company, Limited	Haileybury	June 13	1,500,000
The Bartonville Pressed Brick Company, Limited	Hamilton	July 13	40,000
The Bear Track Mining Company of Porcupine, Ontario, Ltd.	Haileybury	April 29	2,000,000
The Big Four Brick Company, Limited	Toronto	May 14	150,000
The Bouzan Mines, Limited	Haileybury	September 23	2,000,000
The Canada Brick and Fireproofing Company, Limited	Toronto	May 22	500,000
The Canadian Messabe Iron Company, Limited	Fort Frances	November 21	250,000
The Cedar Valley Brick Company, Limited	Toronto	November 13	150,000
The Chippewa Oil and Gas Company, Limited	Berlin	November 1	50,000
The Cleveland Gold Mining Company, Limited	Dryden	November 7	100,000
The Dixie Brick Company, Limited	Toronto	May 21	90,000
The Doric Portland Cement Company, Limited	Owen Sound	April 9	500,000
The Dunn Natural Gas Company, Limited	Dunnville	April 22	40,000
The Emo Iron Mine and Development Company, Limited	Emo	July 23	200,000
The Excelsior Brick Company, Limited	Toronto	November 11	250,000
The Gallagher Lime and Stone Company, Limited	Hamilton	March 21	50,000
The Guelph Brick and Tile Company, Limited	Guelph	September 11	50,000
The Haldimand Gypsum Company, Limited	Caledonia	November 19	150,000
The Humber Cement Brick Company, Limited	Toronto	November 2	40,000
The Ideal Brick and Tile Company, Limited	Brantford	October 22	60,000
The Intercities Quarries Company, Limited	Port Arthur	May 6	500,000
The Ionic Cement and Stone Company, Limited	Owen Sound	August 9	40,000
The Kenora Golden Triumph Mines, Limited	Toronto	April 30	102,000
The Killarney Gold Mining Company, Limited	South Porcupine	April 24	2,000,000
The Kingston Brick and Tile Company, Limited	Kingston	April 4	100,000
The Lake Superior Basin Mining Company, Limited	Fort Erie	February 29	1,000,000

Mining Companies Incorporated in 1912—Continued

Name of Company.	Head Office.	Date of Incorporation.	Capital.
The Mines Leasing and Development Company, Limited	Toronto	December 10.	200,000
The Moira River Mining Company, Limited	Tweed	June 29	1,000,000
The Mount Dennis Brick Company, Limited	Toronto	September 21.	200,000
The New Ontario Oil and Gas Company, Limited	Sheguiandah	June 24	45,000
The Oil Springs Oil and Gas Company, Limited	Oil Springs	April 17	40,000
The Ontario Rock Company, Limited	Toronto	January 20	40,000
The Ontario Stone Company, Limited	Toronto	November 25.	125,000
The Paragon Silver Mining Company, Limited	Collingwood	March 7	500,000
The Paris Brick and Clay Company Limited	Brantford	September 6	100,000
The Porcupine Commander Gold Mines, Limited	Toronto	January 9	1,000,000
The Port Dover Brick and Tile Company, Limited	Port Dover	February 20	60,000
The Pratt Mining Company of Ontario, Limited	Sault Ste. Marie.	September 16.	50,000
The Price-Cumming Brick Company, Limited	Toronto	October 1	100,000
The Ritchie Cut Stone Company, Limited	Hamilton	May 22	40,000
The Star Mica Mining Company, Limited	Kingston	April 19	400,000
The Sterling Silver Mines, Limited	Toronto	September 7	1,250,000
The Streetsville Brick Company, Limited	Toronto	December 19.	100,000
The Sun Brick Company, Limited	Toronto	March 27	350,000
The Union Brick Company, Limited	Toronto	July 11	350,000
The Waines and Root Gas Company, Limited	Dunnville	May 14	400,000
The Worthington-Rowe Lumber and Development Co, Ltd.	Toronto	July 17	100,000
The York Quarry Company, Limited	Toronto	May 3	75,000
Townsite Extension Mines, Limited	Toronto	March 29	100,000
Walsh Mines, Limited	Haileybury	November 4	100,000
Weston Brick Company, Limited	Toronto	April 16	300,000
W. S. M. K. Mining Company, Limited	Toronto	February 16.	200,000
York Ontario Silver Mines, Limited	Cobalt	September 27.	1,000,000
York Sandstone Brick Company, Limited	Toronto	May 15	80,000
		Total	$73,237,000

Mining Companies Licensed in 1912

Name of Company.	Head Office for Ontario	Date of License.	Capital for use in Ontario.
Black Lake Asbestos and Chrome Company, Limited	Toronto	December 23.	$100,000
Dominion Marble Company, Limited	Toronto	November 14.	40,000
German Kali Works	Toronto	November 14.	40,000
The Ashover Fluor Spar Mines, Limited	Toronto	January 23	40,000
The Patricia Mining Syndicate, Limited	Toronto	July 10	£10,000
The Price River Oil Fields, Limited	Windsor	September 18.	$300,000
			$570,000

Mining Divisions

The number and boundaries of the mining divisions remain the same as in 1911. The Recorders, too, are the same, except that at Porcupine, Mr. Gordon H. Gauthier has taken the place of Mr. A. E. D. Bruce, who was appointed as chief clerk to Mr. J. F. Whitson, Commissioner in charge of Northern Ontario improvements.

The list of Divisions and Recorders, together with the receipts on account of mining revenue at the several offices, is as follows:—

Mining Division.	Name and P.O. Address of Recorder.	Receipts.				Total receipts.
		Purchase money.	Miner's licenses	Forest reserve permits.	Recording fees, etc.	
		$	$	$	$	$
Kenora	W. L. Spry, Kenora	2,554 00	1,029 00		947 50	4,530 50
Port Arthur	J. W. Morgan, Port Arthur	6,969 00	2,638 00		2,195 75	11,802 75
Sault Ste. Marie	S. T. Bowker, Sault Ste. Marie	3,643 53	1,935 00		1,040 00	6,618 53
Sudbury	C. A. Campbell, Sudbury	1,583 50	5,314 00	230 00	11,082 70	18,210 20
Gowganda	H. E. Sheppard, Gowganda	12,702 81	1,765 00	340 00	3,467 00	18,274 81
Montreal River	A. Skill, Elk Lake	4,210 91	1,195 00	190 00	1,180 25	6,776 16
Temiskaming	G. T. Smith, Haileybury	13,303 54	10,605 05	160 00	6,945 10	31,013 69
Coleman	" "					
Larder Lake	J. A. Hough, Matheson	8,588 76	1,457 00		8,038 00	18,083 76
Parry Sound	H. F. McQuire, Parry Sound		192 00		194 00	386 00
Porcupine	G. H. Gauthier, Porcupine	11,110 88	7,365 75	420 00	12,185 40	31,082 03
	Total	64,666 93	33,495 80	1,340 00	47,275 70	146,778 43

The remainder of the mining revenue was received by the Department direct from the parties concerned.

The several Recorders briefly report upon the work of their offices for the year as follows:—

Kenora

Recorder, W. L. Spry.—The office issued during the year 79 miner's licenses and 88 renewal licenses; 91 claims were recorded; 21 transfers recorded; 24 certificates of performance of working conditions issued, and 4 certificates of record.

The greatest activity in prospecting and recording has been in the country south of Dryden.

About four miles southeast of Kenora, the Canadian Homestake Mining Company are busy installing machinery and will push development work as soon as their electrical appliances are complete. A power line has been put up from the Kenora Power Company's plant to the mine.

No prospecting to speak of has been done during the year in the Manitou District, the Eagle Lake District, or the Lake of the Woods.

Port Arthur

Recorder, J. W. Morgan.—Miner's licenses issued, 273; renewals of licenses, 269; mining claims recorded, 180; transfers recorded, 51; certificates of record issued, 96; certificates of work, 59.

There has been a decided revival of interest in the iron properties, not only along the Kaministiquia river, but also in the Nipigon Forest Reserve. The silver district west of White Fish lake is also attracting many mining men, and I expect to see this part of Port Arthur Mining Division thoroughly prospected in the near future. Large areas of Thunder Bay District have never yet been prospected.

Sault Ste. Marie

S. T. Bowker, Recorder.—Miner's licenses issued, 216; renewals, 197; claims recorded, 137.

Sudbury

C. A. Campbell, Recorder.—Licenses issued, 469; renewals, 689; forest reserve permits, 20; claims recorded, 776.

There was considerable falling off in the business in comparison with last year. Silver has dropped out of sight. Little or nothing was done in iron. Some staking took place in the nickel field, but this has been so thoroughly prospected, it would appear there is not much likelihood of finding new prospects. The interest centered in gold, principally at West Shining Tree.

About the latter part of May there was some excitement in the neighbourhood of Whiskey lake. Many licenses were taken out, but little recording was done, as those who went in seemed disappointed with the country. In Berths 11, 82 and 90, there has been considerable staking for gold.

Elk Lake

Albert Skill, Recorder.—Certificates of work issued, 50; certificates of record issued, 40; licenses, 55; renewals, 208; mining claims recorded, 126.

During the months of August, September, and October, there was considerable activity in the townships of Cane and Auld, where several native silver discoveries were made. The principal of these are the Hitchcock, Bradley and Charron claims. Development work has been proceeded with on a number of promising properties in the Division, viz.: The Sterling Silver Mines, in the township of Farr; the Donaldson (now the Beaver); the Moose Horn and Beacon Consolidated, in the township of James; and the Paragon, in the township of Willet, which has several promising veins.

Since the advent of the railroad, attention has been turned to the district, and 1913 promises to be an active year.

Gowganda

H. E. Sheppard, Recorder.—Miner's licenses issued, 43; renewed, 305; forest reserve permits issued, 42; claims recorded, 194; certificates of record issued, 118; certificates of work, 395.

Temiskaming and Coleman

George T. Smith, Recorder.—The business transacted in the Temiskaming and Coleman Mining Divisions for the year ending 31st October, 1912, was on the whole fairly satisfactory, and as regards the Coleman area, especially so. Silver mining operations were very active. Large additions were made to several of the plants. New properties were added to the list of shippers, and some which had been closed down have resumed operations.

The opening of a portion of the Gillies limit created widespread interest, and considerable development work has been performed on a number of the claims recorded. The supposed value of the hitherto "forbidden territory" created a rush, owing to hasty and, in many cases, very defective staking and blazing of lines, considerable litigation ensued. In all, about 300 claims were recorded.

In the Temiskaming area, matters were not so favourable. Owing to the fact that a large number of our local prospectors and mining men hold interests in the Porcupine Division, and that very promising gold discoveries have been made in the Larder Lake District (a considerable part of which was until recently included in this Division), South Lorrain and other sections, which looked promising, and with some further research might have made good, have been neglected, and practically nothing beyond the mere development work necessary to protect the claims recorded has been done. Licenses issued, 506; renewals, 1,448; applications, Temiskaming 221, Coleman 295, total 516.

Larder Lake

J. A. Hough, Recorder.—541 applications for claims were recorded, 94 miner's licenses issued, 194 renewals, and 329 transfers registered.

The chief events of interest in this Division for the year were the discovery of high-grade gold ore at Kirkland lake, in the township of Teck, the discovery of gold telluride ore in the township of Beatty, and the development of electric power at Raven lake at the outlet of Larder lake.

Parry Sound

H. F. McQuire, Recorder.—Forty-three miner's licenses were issued, and five new claims staked. The assessment work on the iron claims staked in the township of Lount has been regularly filed, and results are encouraging. The copper and feldspar claims are not showing any activity, and, with the exception of isolated cases, nothing has been done during 1912.

Porcupine

Gordon H. Gauthier, Recorder.—Transfers recorded, 965; certificates of work issued, 111; certificates of record issued, 74; licenses issued, 252; renewals issued, 1,417; claims recorded, 538.

Fort Frances and Eastern Ontario

There are two Mining Divisions in which the amount of business transacted has not so far warranted the expense of appointing a Recorder and maintaining a local office. These are Fort Frances and Eastern Ontario. Under such circumstances the Mining Act provides that the duties of Recorder shall be performed by the Deputy Minister of Mines, and claims which are staked out on Crown lands for mining purposes are recorded at the Department, Toronto.

During 1912 57 claims were recorded in the Fort Frances Division. These were mainly on discoveries of iron ore, and were situated in the townships of Burriss, Crozier, Dance, Dobie, Kingsford, Mather and Miscampbell. Seven claims were cancelled.

In the Eastern Ontario Division 58 claims were recorded on discoveries of iron ore, mica, marble, molybdenite, graphite, talc, gold and silver. The claims were in Frontenac, Renfrew, Hastings, Simcoe, and Peterborough counties, and in the districts of Haliburton and Nipissing. Of claims cancelled there were 15, abandoned 1, transferred 4.

Provincial Assay Office

Mr. W. K. McNeill, Provincial Assayer, reports as follows for the year 1912:—

The Provincial Assay Office which is situated at No. 5 Queen's Park, Toronto, was established in 1898 as an aid to the mineral development of Ontario, and was located at Belleville, until November, 1911, when the change was made to its present location, which is more central and convenient for the work of the Bureau of Mines as well as the public.

The chemical laboratories and assay plant are among the best equipped in the Province and are especially constructed and equipped to give accurate work. The fireroom has a gas muffle furnace with all necessary appliances for careful and accurate assaying of gold and silver ores, while the grinding room is furnished with motor-driven grinders. Special attention is given to the sampling of all ores submitted.

The wet laboratory is supplied with the necessary equipment, and is probably one of the most up-to-date in the Province. Connected with this is the balance room, and an especially equipped room for electro-chemical analysis.

Besides these, there are private offices, library, and store rooms.

Although no new fields were opened up by prospectors during the past year, yet a greater number of silver assays passed through the office than last year, and a renewed activity was noticed in the Elk lake and Gowganda regions, due to the increased price of silver and the prospect of adequate railroad facilities.

A large number of gold samples continue to come in from the Rainy River District and Eastern Ontario, as well as from Porcupine and adjacent districts.

From other parts of the Province were received, gold, zinc, lead, copper, and other ores, besides clays, limestones, feldspars, etc. An active interest was shown in the clay deposits of Ontario, and a large number of samples were analysed and information given respecting their suitability for different purposes. During the year a number of samples of iron pyrites were examined for their sulphur contents and suitability for the manufacture of sulphuric acid, also much work was done in the way of testing samples from limestone deposits for their purity and fluxing qualities. This shows that the interest is not confined to the more precious metals, but that work is being carried on steadily in all branches of the industry.

The work of the office consists of:—

(*a*) Examination and assaying of samples received from mining engineers, geologists, prospectors and the public generally.

(*b*) Analysis of samples of rocks, etc., for the geologists of the Bureau of Mines.

(*c*) The sampling of carload lots of Cobalt silver ore shipped from the mines on which Government collects a royalty. This work is done at the various smelters and is in charge mostly of Mr. T. E. Rothwell.

(*d*) The assaying and valuation of last-mentioned consignments.

The following list of determinations will show the work of the office for the past year:—

	Assays for Bureau.	Assays for Public.	Total.
Gold	70	217	287
Silver	137	124	261
Copper	2	42	44
Cobalt	30	0	30
Nickel	9	25	34
Manganese	0	0	0
Molybdenum	0	1	1
Zinc	0	2	2
Platinum	3	3	6
Lead	0	3	3
Arsenic	4	0	4
Antimony	0	0	0
Tin	1	2	3
	256	419	675

	Analyses for Bureau.	Analyses for Public.	Total.
Metallic Iron	0	6	6
Alumina	80	5	85
Silica	88	4	92
Lime	79	5	84
Magnesia	79	5	84
Ferric Oxide	80	40	120
Ferrous Oxide	13	0	13
Sulphur	0	6	6
Phosphorus	0	4	4
Alkalies	16	1	17
Miscellaneous	80	9	89
	515	85	600

The following is a list of fees for the more common assays and determinations; others will be furnished on application:—

1. Assays:—

Gold	$1.00
Silver	1.00
Gold and silver in one sample	1.50
Platinum	4.00
Gold and Platinum in one sample	5.00
Gold by amalgamation	2.00

2. Iron Ores:—

Iron (metallic)	$1.00
Silica	1.50
Iron and insoluble residue	1.50
Ferrous Oxide	2.00
Ferric Oxide	2.00
Phosphorus	2.00
Sulphur	2.00
Iron, Sulphur, Phosphorus and Insoluble	5.00
Manganese	2.00
Titanium	2.00

3. Limestone, Dolomites, Clays, Shales, etc.:—

Insoluble	$1.00
Silica	1.50
Ferric Oxide	2.00
Ferrous Oxide	2.00
Alumina	2.00
Lime	1.50
Magnesia	1.50
Alkalies (combined)	5.00
Potash	4.00
Water (combined)	1.00
Moisture	.50
Sulphur	2.00
Phosphorus	2.00

4. Ores and Minerals, Determination of:—

Alumina	$2.00
Antimony	3.00
Arsenic	3.00
Bismuth	3.00
Cadmium	3.00
Chromium	3.00
Cobalt	3.00
Copper	1.50
Gold	1.00
Ferrous Oxide	2.00
Ferric Oxide	2.00
Lead	2.00
Lime	1.50
Magnesia	1.50
Manganese	2.00
Molybdenum	3.00
Nickel	3.00
Silica	1.50
Tin	2.00
Water	1.00
Zinc	2.00

Identification of minerals not requiring chemical analysis—Free. Samples will be dealt with in the order of their arrival.

Locality

In every instance, specimens and samples should be accompanied by statement specifying precise locality from which they are taken.

Directions

Crushed sample representing large quantities, or samples less than five pounds weight, may be sent by mail as third-class matter. Send instructions with money in payment in a separate letter. Samples may be sent by express, charges prepaid.

Sample bags addressed to this laboratory for the sending of pulp by mail may be obtained on application. Also canvas bags for shipping.

Terms

Money in payment of fees sent in by registered letter, post office order, postal note or express order and made payable to the Provincial Assayer must invariably accompany samples to insure the prompt return of certificate, as no examination is commenced until the regulation fee is paid.

Samples should be addressed as follows:—

Provincial Assay Office,

No. 5 Queen's Park,

Toronto, Ont.

MINING ACCIDENTS IN ONTARIO

IN 1912

By E. T. CORKILL, Chief Inspector of Mines

During the year 1912 in and about the mines regulated by the Mining Act of Ontario there were 30 fatal accidents, which caused the death of 32 men. The fatalities below ground numbered 26, and above ground 6. Altogether at the mines, metallurgical works and quarries regulated by the Mining Act, there were 40 fatal accidents, causing the death of 43 men, a decrease of 6 from the number killed in 1911. The tables of accidents at the metallurgical works and quarries are separated in this Report from the accidents at the mines.

The total number of serious accidents in the mines of Ontario reported to the Bureau of Mines in 1912 was 238, resulting in 32 killed and 216 injured; of these casualties, 186 occurred below ground and 62 above. The fatal accidents took place in mines operated by 19 different companies. At metallurgical works there were 128 accidents, which caused the death of 10 and serious injuries to 122 men. The total number of accidents during the year 1912 at the various mines and works regulated by the Mining Act of Ontario is therefore 370, causing the death of 43 and injuries to 341 men.

An investigation and report were made in 29 out of the 30 fatal accidents in the mines, in all the fatal accidents at the metallurgical works, but not in the single quarry accident. In accordance with the requirements of the Mining Act, inquests were held in the majority of cases and were attended either by the Assistant Inspector of Mines or the writer.

Analysis of Fatalities at Mines

By months the 32 fatalities occurred as follows:—January, 3; February, 3; March, 2; April, 2; May, 3; June, 1; July, 2; August, 2; September, 3; October, 3; November, 4; December, 4; total—32.

A comparison of the causes of the fatalities at the mines for 1911 and 1912 is as follows:—

Cause.	191 .	1912.
	Per cent.	Per cent.
Falls of ground	5.5	9.4
Shaft Accidents	22.2	25.0
Explosives	44.5	21.9
Miscellaneous (underground)	19.5	25.0
Surface	8.	18.7

The following classification distributes the responsibility for the cause of the fatalities at the mines:—

1. Fatalities due to danger inherent to the work itself	10 or 23.3	per cent.
2. Fatalities arising out of defects in the mine workings	8 or 18.6	"
3. Fatalities due to fault of fellow workmen	1 or 2.3	"
4. Fatalities due to fault of injured person	23 or 53.5	"
5. Fatalities unclassifiable	1 or 2.3	"

There were employed at the producing and non-producing mines in 1912 approximately, 9,500 men. At these mines 32 men were killed, which is equivalent to 3.36 per 1,000 men employed.

Table of Fatal Accidents in Mines, Metallurgical Works and Quarries, 1901 to 1912.

	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	Total.
Persons killed in producing and non-producing mines......	13	10	7	7	9	11	22	47	49	48	49	43	315
Persons employed in producing mines.....................	4,135	4,426	3,499	3.475	4,415	5,017	6.305	7,435	8,505	10,862	12,543	13,108	83,625
Persons employed in non-producing mines (estimated)..	550	450	400	400	500	750	1,140	1,750	2,000	2,000	2,000	2,000	13,940
Total persons employed........	4,685	4.876	3.899	3,875	4 915	5,767	7,345	9,185	10,505	12,862	14,543	15,108	97,565
Fatal accidents per 1,000 employed.....................	2.77	2.05	1.79	1.80	1.83	1.90	2.99	5.11	4.66	3.73	3.37	2.84	3.22

Cause and Place of Fatalities in Mines

The following schedule shows the cause and place of the fatalities in 1912 compared with 1911:—

		1912		1911
Below ground:—				
Falls of ground		3		2
Shaft accidents:—				
Falling down shaft	4		3	
Objects falling down shaft	2		1	
Falling from bucket	1		3	
Run over by skip	1		0	
Falling down shaft due to staging giving way.............	0		1	
	—	8	—	8
Explosive accidents:—				
Premature explosion while loading or lighting holes........	0		5	
Drilling into bottom of old or missed holes..................	1		3	
Explosion of box of dynamite while preparing charges......	0		3	
Asphyxiation from gases from explosives	5		3	
Picking or putting bar into old hole containing explosive...	1		2	
	—	7	—	16
Miscellaneous accidents:—				
Falling down winze	3		0	
Falling down stope	2		1	
Struck or buried by ore....................................	2		0	
Struck by bar while barring ore from chute................	1		0	
Falling down chute	0		3	
Struck by steel, etc., falling down stope or from staging....	0		3	
	—	8	—	7
Above ground:—				
Blowing up of thawing house..............................	1		2	
Struck by falling objects	2		1	
Electrocuted	1		0	
Falling from ladder	1		0	
Burned	1		0	
	—	6	—	3
		—		—
Total		32		36

The specific occupation in the mine of the men killed and their nationality are shown in the following table:—

Occupation	English Speaking	Finlander	Italian	Polander	Swede	Austrian	Syrian	German	Total
Drill runner	4	4	1	1					10
Trammer			1	1			1	1	4
Mine captain	2								2
Drill helper		2							2
Scaler		2							2
Pumpman	1				1				2
Laborer	1		1						2
Skip tender			1						1
Engineer	1								1
Track layer					1				1
Timberman						1			1
Nipper						1			1
Carpenter	1								1
Watchman			1						1
Chute tender			1						1
Total	10	8	6	2	2	2	1	1	32

The ages of the men killed at the mines were as follows:—

17–20	21–25	26–30	31–35	36–40	41–45	46–50	Unknown	Total
1	8	6	7	3	4	1	2	32

Cause and Place of Non-Fatal Accidents at Mines

The following schedule shows the cause and place of the non-fatal accidents in 1912 at the mines and the number injured:—

Underground:—		
Falls of ground		13
Shaft accidents:—		
Cage accidents	4	
Falling part way down shaft	4	
Objects falling down shaft	4	
Miscellaneous	2	
		14
Explosives:—		
Drilling into old or missed holes	11	
Picking into explosives	3	
Premature explosion	3	
		17
Miscellaneous accidents:—		
Falling down stopes, raises, winzes, chutes or man-ways	11	
Jammed by cars, skips, buckets or pieces of rock or ore	39	
Scaling	2	
Falling from staging	6	
Foreign material in eyes	6	
Fall of rock or ore down chute	15	
Burned	2	
Flying rock	3	

Rock rolling down pile	7	
Caught by drill	3	
Falling objects	4	
Miscellaneous	19	
		117
Surface:—		
Falling from elevated places	14	
Caught by machinery	10	
Flying rock	1	
Burned by electric wire	1	
Falling objects	4	
Explosion of boiler tube	1	
Burned	1	
Miscellaneous	23	
		55
Total		216

The specific occupation at the mine of the men who were injured and their nationality is shown in the following table:—

Occupation.	English Speaking.	Italian.	Polander.	Finlander.	Russian.	Austrian.	Roumanian.	Spanish.	German.	Bulgarian.	Swede.	Hungarian.	Bohemian.	Nationality Unknown.	Total.
Trammer	5	27	23	10	4	2	....	3	....	1	....	....	....	1	76
Drill runner	21	5	6	7	2	1	1	....	....	....	....	1	....	....	44
Drill helper	6	....	4	9	....	....	1	....	1	....	....	....	....	....	21
Laborer	7	2	1	....	....	1	1	....	....	....	1	....	....	....	13
Carpenter	10	....	....	....	....	....	....	....	....	....	....	....	....	....	10
Hammerman	1	....	....	4	....	....	....	....	....	....	....	....	....	2	7
Mill-man	6	....	....	....	....	....	....	....	....	....	....	....	....	....	6
Timberman	3	....	1	1	....	....	....	....	....	....	....	....	....	....	5
Trammer boss	3	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Iron worker	1	2	....	....	....	....	....	....	....	....	....	....	....	....	3
Skiptender	1	1	....	1	....	....	....	....	....	....	....	....	....	....	3
Painter	2	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Scaler	....	....	....	2	....	....	....	....	....	....	....	....	....	....	2
Fireman	1	....	....	....	....	....	....	....	....	....	....	....	1	....	2
Deckman	....	....	2	....	....	....	....	....	....	....	....	....	....	....	2
Mason	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Boilermaker	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Foreman	....	....	....	....	....	....	....	....	1	....	....	....	....	....	1
Shift boss	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Trackman	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Fitter	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Master mechanic	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Teamster	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Tile layer	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Sledger	....	....	....	1	....	....	....	....	....	....	....	....	....	....	1
Electrician	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Pumpman	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Straw boss	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1
Hoistman	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Superintendent	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Sampler	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Oiler	1	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Total	78	41	37	35	6	4	3	3	2	1	1	1	1	3	216

The ages of the men injured at the mines were as follows:—

17–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	Unknown	Total
5	53	43	32	16	8	6	1	1	1	50	216

The following table shows the time during which the injured persons were incapacitated for work:—

Class of Work	1 to 2 Weeks	2 to 3 Weeks	3 to 4 Weeks	4 to 5 Weeks	5 to 6 Weeks	6 to 7 Weeks	7 to 8 Weeks	8 to 9 Weeks	9 to 10 Weeks	10 to 12 Weeks	Over 12 Weeks	Permanent	Not Reported Cured	Total
Mines—														
Above ground	21	11	2	6	3	2	1	1	1	2	4	1	1	56
Below ground	56	31	21	11	11	4	4	5	1	3	8	1	4	160
Metallurgical Works	53	16	15	6	4	2	1	1	....	....	5	1	18	122
Quarries..................	....	1	....	....	1	....	....	....	....	....	....	....	1	3
Total	130	59	38	23	19	8	6	7	2	5	17	3	24	341

Mining Regulations and How Observed

There was an improvement during the year in the observance of the regulations by the mining companies. This is shown by the fatalities arising out of defects in the mining works falling to 18.6 per cent., compared with 27.8 per cent. during the preceding year. The fatalities due to carelessness, neglect and foolhardiness on the part of the workmen themselves increased largely, there being 23 fatalities, or 53.5 per cent. due to the fault of the injured person, and 2.3 per cent. due to the fault of a fellow workman, compared with 38.9 per cent. during the preceding year. The record shows that 74.4 per cent. of the fatalities were due to the fault or neglect of the workmen or the managers of the work, and were preventable accidents. The other 11 fatalities, or 25.6 per cent., were due to danger inherent in the work itself.

Negligence by mine managers in carrying out the regulations and in permitting dangerous mining practices has caused serious and in some cases fatal accidents. Such negligence has been manifested with regard to the following:—

1. The proper and efficient scaling of the roofs and walls of working stopes, shafts, drifts and cross-cuts.
2. The proper ventilation of underground workings.
3. The proper installation of high voltage wires.
4. The erection and maintenance of approved thawing houses.
5. The enforcement of rules regarding the careful handling of explosives.

The provisions that are most frequently broken by the workmen have reference to:

1. Proper care in the handling of explosives.
2. Drilling into missed or cut-off holes.
3. Drilling into the bottom of old holes that have been blasted.
4. The tamping of holes after charging.
5. Riding in buckets or skips.
6. Keeping in position guard-rails around shaft openings.
7. Proper scaling of walls and roofs of working places.
8. Getting on or off cages in motion.

Mr. T. F. Sutherland, Assistant Inspector of Mines, resident at Cobalt, makes the following comments on the accident rate in the mines along the line of the Temiskaming and Northern Ontario railway:—

> There were 16 fatalities in this district during 1912, and of these 7 can be classified as due to carelessness. There were 3 fatalities from asphyxiation by gas from explosives, and these were partly due to carelessness and partly to the lack of knowledge of the dangerous properties of the gases resulting from the explosion. One fatality in Porcupine was the result of electric shock. In this case the mining company was in fault in sending a workman inexperienced in electrical work into an unsafe transformer-house. Of the remaining 5 fatalities, one was probably due to an epileptic fit, one partly the fault of the company, and the remaining 3 may be classified as unavoidable.
>
> The majority of non-fatal accidents were due to carelessness and incompetence of the injured persons.
>
> Several accidents resulted from improper scaling. Blasting accidents have been very few during the year. In mines where each drill runner does his own blasting, as in Ontario, the prevention of blasting accidents depends largely on the care taken by the men themselves and the supervision of the shift bosses.
>
> The mine captains and shift bosses of the mines of this district are as a rule careful regarding the safety of the men employed, and there is a direct relationship between the attitude of the men in charge of underground operations regarding accidents and the number of accidents in any mine.

The following notes briefly describe the fatal accidents at the mines from the various causes, and the methods that should be adopted for their prevention.

Falls of Ground

There were three men killed from falling rock, an increase of one over the preceding year. One man was killed while walking under a large piece of rock that he was trying to take down; the rock fell, striking and injuring him so severely that he died shortly afterwards. Another man was killed while taking down rock. The piece he was working at fell, bringing with it a larger block, which fell upon him. The third man was killed by being struck by a small piece of rock falling from the hanging wall. This accident was due to careless scaling.

Shaft Accidents

There were eight fatalities in shafts in 1912, being the same number as in **1911** and also in 1910.

Four men lost their lives through falling down a shaft. One of these men was getting off the cage at the surface when it was a few feet above the landing and fell back into the shaft. Another in some manner unknown was caught by the timber and fell into the shaft while riding up on the cage. Another man lost his life while engaged in timbering in the shaft, through the slipping of one of the ropes which held the staging. A mine captain was killed apparently by being overcome by gas from the explosives and falling down a shaft that was being raised to surface.

Two men were killed by being struck by a piece of rock or ore falling down shaft. One of these men was unwatering an old shaft, and through negligence in scaling or cleaning off the timbers, a piece of rock had been left which fell and struck him while he was standing on the pump preparing to lower it.

One man was killed through falling from a bucket, and another by being run over by a skip on which he had been riding. Both were violating the provisions of the Mining Act.

All of the above shaft accidents were preventable, and could have been avoided if reasonable care had been taken. Most of these accidents were due to the carelessness or foolhardiness of the workmen.

It is necessary to again point out that the type of cage commonly used in the mines of Ontario is not satisfactory. It is advisable to have closed-in cages with some kind of sliding door at least four feet in height, so that no one can get off or on when the cage is in motion, or caught by the timbers through standing too close to the edge of the cage.

Accidents from Explosives

There was a marked decrease in the number of accidents from explosives in 1912, compared with 1911 and preceding years, there being but 7 fatalities as against 16 in 1911 and 10 in 1910. This shows that greater care is being taken in the handling of explosives, and also stricter supervision by the men in charge of the mines. It is also possible that the introduction of low-freezing explosives may have been a factor in the lower accident rate.

One man was killed by drilling into a missed or cut-off hole, and another from picking into the explosive. The first of these was due entirely to the recklessness of the workman.

In the non-fatal accidents, there were 17 workmen injured during the year, of whom 11 received their injuries through drilling into old or missed holes. This shows that this dangerous practice is still more or less prevalent.

Information was laid against three workmen for violation of the rule which forbids drilling into the bottoms of old holes that have been blasted.

Three casualties were due to picking into explosives, and three to premature explosions. The latter all occurred while the workmen were sand-blasting and were due to the fuse spitting into insufficiently covered explosives. Such accidents are preventable, and are due to carelessness in preparing for the blast.

Five men were asphyxiated by gases from explosives in 1912, the number in 1911 being three. In addition, many were rendered temporarily unconscious. These cases are nearly always due to improper ventilation of the underground workings. Occasionally, the men are affected through returning to work too soon after blasting. In one accident the mine captain and pumpman lost their lives in a winze about fifteen hours after the blasting took place. The question of ventilation of mines is taken up later in this Report.

Miscellaneous Accidents

There were 8 men killed in miscellaneous accidents underground, compared with 7 in 1911. Of these, 4 were killed in stopes, 3 by falling down winzes, and 1 in a drift. Of the 4 killed in stopes, 2 of the fatalities were the result of falls, and 2 through being struck or buried by ore. The method of mining was responsible for the fall of the men in the stopes. The ore is so mined that before it is all removed it is often necessary for the men to work in such a position that a misstep will cause their fall down the stope.

Of the three men killed by falling down winzes, one was due to the guard-rail not being in position; the man pushed the bucket into the winze and fell with it. Another man returned to the winze too soon after blasting out timbers near the collar and fell into it; this accident was possibly due to the caving of loose material. Another man was running a machine near the mouth of the winze and fell backward into it. This accident was also the consequence of improper mining methods.

There were in all 117 non-fatal miscellaneous accidents. Of these the greater number were not serious, incapacitating the men for work from one to two weeks, and consisting chiefly of cuts or bruises due to having hands or feet jammed by cars, skips, buckets, or pieces of rock or ore. Eleven men were injured by falling down stopes, raises, winzes, chutes, or manways. Some of these accidents might easily have resulted seriously, and the prevalence of such casualties shows the necessity for guarding all working places and openings as thoroughly as the conditions will admit.

Particulars of these non-fatal accidents are given on subsequent pages.

Surface Accidents

Six men were killed on the surface about the mines in 1912, double the number of the preceding year. Of these, one was killed by the blowing up of a thaw-house. In this case it was impossible to ascertain the cause of the explosion. Two men were killed through being struck by falling objects. In one case, a gang of workmen were hoisting a gin pole by means of a winch, the axle of which broke and allowed the gin pole to fall back on a pike pole, breaking the latter and killing the man. Another man fell with a trestle from which he was endeavoring to loosen a guy line. He untied the wrong rope, causing the fall of the trestle, which injured him so severely that he died a few days later. Another man met his death by coming in contact with high-voltage wires in a transformer room. This accident was due to the improper construction of the transformer house. Information was laid against the company for a violation of Rule 64 of Section 164 of the Mining Act, and a fine of $100.00 and costs was imposed. Another man fell from a ladder in a hoist house, due to the breaking of a steam valve, and received injuries which caused his death. A watchman employed at one of the mines, who was subsequently ascertained to have been subject to epileptic fits, was found dead in the crusher building, his clothes having been set on fire by his lantern.

There were 54 men who received injuries while working on the surface around the mines. Most of these injuries were not serious, and incapacitated the workmen for one to two weeks only. The more serious were caused either by falling from elevated places or being caught in machinery. There were six men who received fractures through falling from elevated places. These men were incapacitated from one to three months. Five men received fractures and lacerations through being caught in machinery, and two others each had an arm so badly lacerated and broken from being caught in a conveyor belt that amputation was necessary. One man lost his eyesight through being burned by caustic soda. Two others suffered fractures of the leg, one by being run over by the skip and the other through the breaking of a chain.

Prosecutions

Prosecutions for infringement of the Mining Act were undertaken by the Inspector of Mines, with results as follows:—

1. A company was fined $100 and costs for a violation of section 164, rule 64, of the Mining Act, in not having an electrical apparatus efficiently covered and safeguarded.
2. A workman was fined $10 and costs for a violation of section 164, rule 31, in riding on a skip.
3. A workman was fined $15 and costs for a violation of section 164, rule 13, in drilling into the bottom of a hole that had been blasted.
4. Two workmen were each fined $10 and costs for a violation of the last-mentioned rule.

Health of Miners

The health of the workmen employed at the mines during the year was good. There was but little typhoid at any of the camps, and the older camps were remarkably free from it. As far as can be ascertained, there are not as yet many cases of miner's phthisis, which is so prevalent in many mining countries. It is, however, difficult to ascertain to what extent this disease has begun to make inroads. When men become sick at the mines or feel unable to work, they leave at once for their old homes and are lost track of. There is no doubt, however, that with the increased use of hammer drills, which cause much dust in drilling operations, there is grave danger of miner's phthisis spreading and becoming a serious menace to the health of all underground employees. This is more particularly true in mines where the gangue is chiefly quartz. Steps have been taken to keep down the dust from drilling operations by ordering all the mining companies to have their drills equipped with a water spray.

Miner's Phthisis in the Transvaal

The following quotations from the Report of the Mining Regulation Commission of the Transvaal show the prevalence of miner's phthisis in that colony and the means recommended to mitigate the evil:—

> It is well known that persons such as cutlers, potters, quarrymen, filemakers, felt hat finishers, lead and tin miners, who are more or less continuously inhaling hard, sharp, irritating dust, show an undue mortality from respiratory disease after the age

of about 35. Naturally this is less marked in the case of open-air workers such as quarrymen than in men who work underground or in cover. On the other hand, in the case of rock-drillers, this mortality begins much earlier and is much heavier. From the reports of the Transvaal Government Mining Engineer for 1901 and 1902 (quoted by Dr. Haldane) it appears that between October, 1899, and January, 1902, the war being in progress and mining operations practically suspended, the annual death rate among the men who had been employed in the Transvaal as rock-drillers before the war was no less than 73 per 1,000, and this during a period when the great majority were not actually engaged in rock-drill work. The corresponding figure for Cornish rock-drillers is estimated by Dr. Haldane at about 60 per 1,000; while the Victorian statistics, published by Dr. Summons, indicate that in the Bendigo mines the mortality is higher even than in the Transvaal. The disease has consequently been the subject of careful official inquiry in all these localities, viz., in the Transvaal by the Miners' Commission of 1902-03; in Cornwall by Dr. Haldane, with Messrs. Martin and Thomas, who reported in 1905 "On the Health of Cornish Miners"; in Australia by the Commission of 1905 "On the Ventilation and Sanitation of Mines in Western Australia," as well as by Dr. Walter Summons who in 1907 published an excellent and illuminating report on miner's phthisis at Bendigo, Victoria. In each of these localities miner's phthisis has very greatly increased since the general introduction of rock-drills into practice, and those who have investigated the matter are generally agreed as to the nature of the disease, which is thus summarized by Drs. Irvine and Macaulay:—

"It is primarily a chronic disease of the lungs, characterized by slow but progressive fibroid changes in the lung tissue and the pleuræ, accompanied by chronic catarrhal processes in the air-cells and respiratory passages. All are agreed that immensely the most important factor in producing this condition is the more or less continuous inhalation over long periods of fine rock-dust. All true cases of miner's phthisis are thus primarily cases of silicosis; silicosis is the feature common to them all. Finally, it is agreed that, in the later stages, tuberculous infection commonly, or invariably, becomes super-imposed upon this condition, and the symptoms and course of the disease alter accordingly."

Duration of the Disease. From the evidence before us it appears that, in the past, the average age at death of rock-drillers dying from silicosis in the Transvaal was thirty-five years, and the average period of rock-drill employment was seven to nine years. Dr. Haldane gives the following figures for rock-drillers dying in Cornwall:—

Where work has been done.	Average Age at Death in 142 cases	Average Period of Rock-drill Employment when ascertainable.
Cornwall only	37.5	8.4
Cornwall and Transvaal	36.4	4.7
Transvaal only	36.3	11.6

During 1905-07 the average age of mine employees dying of phthisis on the Rand was 39 years. At Bendigo, the incidence of the disease is, as already pointed out, considerably heavier than on the Rand, but the average age at death is much higher than here, viz., year by year just under or above fifty years, the presumption being that the development of silicosis is much more gradual and the Bendigo miner's term of active usefulness correspondingly longer.

Preventive Measures.—From the foregoing considerations it is clear that our efforts must be directed to

1. The prevention of dust inhalation;
2. The prevention or removal of noxious fumes resulting from explosives;
3. The prevention of tuberculosis.

(1) The Prevention of Dust Inhalation.—The rock-driller is far more exposed to dust than any other miner. This dust is produced (*a*) by drilling dry holes and (*b*) by blasting. In dry working places it is raised again after its subsidence (*a*) by the air escaping from the rock-drills and (*b*) by the lashing or shovelling of broken rock which is not wet. Holes drilled from above downwards are usually kept filled with water, and, as work progresses, exude only mud; "backholes," or holes drilled from below upwards, will obviously not retain water, and unless a jet or spray be played upon them, give off a continuous stream of fine dust. The chief occasions of dust inhalation are therefore (*a*) when the escaping air from the rock-drills raises the dust from the floor and sides of dry working places; (*b*) in drilling backholes; (*c*) on returning to the working face after blasting before the dust has had time to subside; and (*d*) in lashing without keeping the rock thoroughly wet.

Mine Hospitals

The mine hospital at Cobalt continues to do most efficient work for both the sick and the injured employees of the mines in the Cobalt camp. The directors have purchased a Roentgen ray machine, and have it set up in the hospital.

The last annual report of the Hospital Board for the year ending February 28th, 1912, gives the following particulars:—

Patients in hospital March 1st, 1911	15
Patients admitted during year	350
	365
Patients discharged during year—Deaths	12
Recovered	344
	356
Patients in hospital March 1st, 1912	9
Average patients per day in hospital	17
Average days per patient in hospital	17

	Deaths.	P.C. Deaths.	P.C. Recovery.
Pneumonia	3	17.6	82.4
Typhoid	2	8.5	91.5
Diphtheria	1	7.7	92.3
Heart failure	1	....	....
Accident	5	4.5	95.5
Medical cases	7	3.8	96.2
Surgical cases	5	2.8	97.2
Total cases	12	3.3	96.7

Three deaths included under "Accident" were of private patients, and not from mines. Death resulted in two cases during the operation, and the other in five hours after operation.

Three hospitals have been built and equipped for the use of the mines in Porcupine. One is at the Dome mine, and has been built and equipped for the employees of this mine. Another hospital has been equipped at Pearl lake, and is under the supervision of Dr. Moore. The mines in the vicinity of Pearl lake are subscribers to this hospital, and their employees are treated there. A third hospital has been erected in the town of Timmins, and is being looked after by the Sisters of the Roman Catholic Church. The employees of the Hollinger mine are cared for here.

Owing to the hospital of the Canadian Copper Company at Copper Cliff being destroyed by fire in January, 1912, a temporary hospital was fitted up, and the injured and sick employees of the company looked after there. A new hospital is now in course of construction.

Labor

The supply of skilled labor through all the mining camps during the year was barely sufficient. There was, however, no labor trouble until the latter part of the year, when the employees of the mines in Porcupine went out on strike, demanding an 8-hour day for underground labor and protesting against a reduction in wages. The strike is still unsettled.

Ventilation of Mines

The most serious form of accident in the mines during the year was from gases emanating from the discharge of explosives. Five men lost their lives from this cause compared with three in the preceding year. The lack of good ventilation in the mines is certainly responsible for the majority of these accidents. In addition to the fatalities there is also to be considered the effect of the gases on the health of the men working therein; and the evils due to fine dust in the mine air.

The poisonous gases produced by the discharge of explosives are mainly carbon dioxide, carbon monoxide and nitrous fumes. Of these the most dangerous is carbon monoxide. The Mining Regulations Commission of the Transvaal state as follows regarding mine ventilation:—

Poisoning by carbon monoxide most frequently follows the ignition and subsequent explosion of large quantities of explosives. The usual history is that exposure to stagnated fumes has taken place two or more hours after the explosion in places where the local ventilation is defective and the air stagnates after blasting, *e.g.*, in the dead-ends of drives, in raises, and very notably in winzes, which are often entered (usually by colored laborers) before the fumes are blown out. Symptoms of poisoning supervene rapidly, though not so quickly as in gassing by nitrous fumes, and special danger lies in the fact that those affected are, without being aware of it, stupefied and rendered unconscious, and therefore incapable of effecting an escape. Cherry-red discoloration of the blood and tissues is, of course, a marked post-mortem characteristic.

Nitrous Fumes.—The action of nitrous fumes on the human system and the dangerous effects of its presence in the air have been dealt with by Drs. Irvine and Macaulay, who found that 47 out of 172 deaths from gassing were due to this gas. Owing to its solubility in water it is rarely present in mine air more than one hour after the detonation or burning of explosives. We are of opinion that no determinable amount of this gas should be allowed in mine air.

Treatment of Gassing

1. Every case of gassing should be at once reported to the shift boss and by him to the mine manager either directly or through the mine captain.

2. All cases of gassing should be brought to the fresh air as quickly as practicable, and kept warm by the application of warm clothing and other external means. The common practice of sousing such cases externally with cold water and of administering whisky or brandy internally should on no account be employed, because of the physiological shock produced.

3. If the sufferer can swallow, an emetic (one ounce of sulphate of zinc solution, strength 30 grains to ounce) should be at once given, and repeated every ten minutes till vomiting results.

4. When vomiting has occurred, a dose of two teaspoonfuls in water of aromatic spirits of ammonia (sal volatile) should be administered.

5. Artificial respiration should be started and continued as long as there is any indication of life, the patient thereby being made to inhale oxygen through a mask. Oxygen in such cases is invaluable; carbon monoxide is eliminated five times as rapidly in an atmosphere of oxygen as in air, and in nitrous fumes poisoning the beneficial effect of oxygen on the terrible distress of pulmonary œdema is most marked.

In the latter treatment of nitrous fumes gassing, the medical attendant may have to resort to saline transfusion and liberal blood-letting.

6. All cases of gassing, however slight, should be kept under medical observation for at least twelve hours.

We therefore submit the following recommendations:—

(*a*) That the legal maximum for noxious CO_2 permissible in mines in the Transvaal be fixed at 8 parts by volume in 10,000 of air.

(*b*) That an amount of 4 parts of CO_2 by volume in 10,000 of air shall be allowed in addition to the aforesaid maximum as representing innocuous CO_2 normally present in the atmosphere.

(*c*) That where candles or similar illuminants are in use, a further addition of 3 parts of CO_2 by volume in 10,000 of air shall be allowed as representing innocuous CO_2 resulting from the combustion of such illuminants.

(*d*) That in order to meet, from the point of view of practical administration, difficulties in regard to possible innocuous CO_2 from country rock and other uncertain sources in the mines of the Rand, a further allowance of 5 parts per 10,000 be made, making a total limit of 20 parts per 10,000 of air. That in view of the extremely poisonous effects of carbon monoxide and nitrous fumes on the human system, and the frequency of gassing fatalities on the Rand, we also recommend that the maximum permissible amount of carbon monoxide in any part of a mine shall not exceed .01 per cent., and no practically determinable amount of nitrous fumes shall be permitted in any part of a mine.

Tables of fatal and non-fatal accidents follow:—

Table of Fatal Accidents in or

Number.	Date.	Name of Mine.	Name of Owner.	Name of Injured.	Occupation of Injured.
	1912				
1	April 1..	Bessemer....	Canada Iron Mines.	Whit Hogle	Engineer ....
2	Feb. 13..	Crean Hill...	Canadian Copper Co	John Timperpakka....	Scaler...........
3	Mar. 7..	Creighton....	" "	Robt. Malinen........	Drill runner .....
4	April 20..	No. 2........	" "	Wm. Karkanen	" .....
5	Sept. 9..	Creighton....	" "	Leo Porco	Skip tender......
6	Sept. 14..	No. 2........	" "	Preeio Dymter.......	Trammer........
7	Oct. 3..	Creighton....	" "	Pietro Mascaro.......	" ....
8	Nov. 23..	Frood	" "	D. Tikkanen	Drill helper......
9	Nov. 28..	Creighton....	" "	Henry Salo..........	Drill runner......
10	Dec. 9..	"	" "	Henry Heino.........	Scaler...........
11	Nov. 10..	Casey	Casey Cobalt Mg. Co.	David Roberts	Mine captain.....
				Chas. Lindberg	Pumpman ....
12	Jan. 10..	Cordova	Cordova Mines, Ltd.	Bert Easton..........	Pumpman ....
13	May 31..	"	"	John Pressie.........	Drill runner......
14	Jan. 26..	Dome........	Dome Mines, Ltd ...	Albert Ohlander......	Track layer......
15	Mar. 30..	"	" ...	Nello Rea............	Watchman.......
16	Dec. 20..	"	" ...	Luigi Mezzeroba......	Trammer........
17	Jan. 9..	Hollinger	Hollinger Gold Mines, Limited.	A. Lahte	Drill runner......
18	June 12..	Kerr Lake...	Kerr Lake Silver Mines.	W. Green	Drill runner......
19	Dec. 2..	Helen	Lake Superior Power Co.	H. M. Ephraim.......	Mine captain.....
20	July 5..	McIntyre	McIntyre Porcupine Gold Mines, Ltd.	Gilbert Martin.......	Laborer ....
21	Aug. 20..	McKinley-Darragh..	McKinley-Darragh-Savage Mines, Ltd	Joseph Rochfort......	Carpenter........
22	July 19..	Moose M'n...	Moose Mountain, Ltd	Monusa Luigi	Laborer ....
23	May 3..	Nipissing....	Nipissing Mining Co.	Quintino Gizzi........	Drill runner......
24	Aug. 9..	O'Brien	M. J. O'Brien	Z. Raezkiewiez	Trammer........
25	Feb. 13..	Peterson Lake	Peterson Lake Mg.Co	John Deep	Trammer........
26	Oct. 7..	St. Anthony..	Sturgeon Lake Development Co.	S. Jones...............	Drill runner......
				J. Mikaranto	Drill helper......
27	Sept. 4..	Temiskaming	Temiskaming Mg. Co	Frank Juretich	Timberman......
28	Dec. 5..	Trethewey ..	Trethewey Mg. Co..	Yau Uhryn	Nipper ....
29	May 27..	Vipond	Vipond Porcupine Mines Co., Ltd.	M. Buchanan.........	Drill runner......
30	Feb. 24..	West Dome..	West Dome Mines. Ltd.	James Riley	Drill runner......
					Total.........

about the Mines, 1912.

Nationality of Injured.	Age.	Married or single	Below ground.	Above ground.	Cause of Accident.
English speaking..	42	M	....	1	Steam valve over hoist broke, causing fall and fracture of right leg. Died May 10.
Finlander	34	M	1	....	Struck by falling rock, causing fracture of leg and other injuries.
Finlander	29	M	1	....	Fell from bench on open stope.
Finlander	34	M	1	....	Struck by piece of ore falling from pile.
Italian	35	M	1	....	Struck by piece of ore falling down shaft, causing fracture of skull.
Polander	20	S	1	....	Jumped off skip while in motion, was run over and had neck broken.
Italian	24	M	1	....	Suffocated by pile of broken ore.
Finlander	23	S	1	....	Fell down shaft and injured internally.
"	27	S	1	....	Struck by falling rock; leg and ribs fractured.
"	22	S	1	....	Fell down stope and fractured skull.
English speaking..	48	S	1	..	Asphyxiated by gas in winze.
Swede............	33	M	1	..	
English speaking..	27	M	1	....	Skull fractured by rock falling in shaft.
" ..	33	M	1	....	Fell down winze.
Swede	32	M	1	....	Fell from bucket.
Italian	45	M	....	1	Evidently fell in epileptic fit and clothes were set on fire by broken lantern.
"	45	M	1	....	Struck by bar while prying ore in chute and fractured skull.
Finlander	35	S	....	1	Blown to pieces in thaw-house explosion.
English speaking..	28	M	1	....	Fell down shaft.
" ..	28	M	1	....	Overcome by gas and fell down raise.
" ..	45	M	....	1	Electrocuted. Came in contact with wire carrying 12-000 volts.
" ..	36	M	....	1	While erecting gin pole winch broke causing pike pole to break, striking him and fracturing skull.
Italian	26	S	....	1	Fell with trestle and fractured leg.
"	24	S	1	....	Overcome by gas.
German	23	S	1	....	Skull fractured by falling rock.
Syrian	24	S	1	....	Fell down winze.
Polander	....	S	1	..	Asphyxiated by gas.
Finlander.........	....	M	1	..	
Austrian..........	37	S	1	....	Fell down winze and fractured skull.
Austrian	21	S	1	....	Fell from cage down shaft and fractured skull.
English speaking..	40	S	1	....	Picked into piece of explosive in muck pile, explosion followed, causing fracture of skull. Died in Buffalo, N.Y., June 24.
English speaking..	25	S	1	....	Drilled into missed hole.
....	....	....	26	6	

Table of Non-Fatal Accidents

Number.	Date of Accident.	Date of Recovery.	Name of Mine.	Name of Owner.	Name of Injured.	Occupation of Injured.
1	May 29	Aug. 12	Armstrong-McGibbon	Armstrong-McGibbon Syndicate	Wm. Bradley	Hammerman
2	Feb. 6	Perm'ly disabled	T. R. S., 1398 and 1399	Bartram, Wadsworth and Sherry Syndicate	John Novack	Foreman
3	Jan. 13	Mar. 12	Beaver	Beaver Consolidated Silver Mines, Ltd.	R. Purdy	Painter
4	April 25	May 2	Beaver	Beaver Consolidated Silver Mines, Ltd.	M. Colton	Drill runner
5	Oct. 25	Nov. 25	Beacon	Beacon Consolidated Mines	L. Annitt	Hammerman
6	Nov. 20	Jan. 21	do	do do	O. Saari	do
7	Jan. 31	Feb. 16	Buffalo	Buffalo Mines, Ltd.	Wm. Toeppner	Shift boss
8	Feb. 7	" 28	do	do do	R. Stewart	Drill helper
9	" 29	Mar. 7	do	do do	A. Jones	Painter
10	Mar. 29	April 15	do	do do	A. Giovanella	Trammer
11	April 6	Aug. 26	do	do do	Jas. Nowork	Drill runner
12	Aug. 1	Sept. 1	do	do do	Thos. McIntyre	Carpenter
13	Sept. 14	....	do	do do	Thos. Patterson	Drill helper
14	" 20	Oct. 1	do	do do	Geo. Kozalauki	Trammer
15	Nov. 2	Nov. 18	do	do do	B. Williams	Laborer
16	Mar. 28	July 31	Creighton	Canadian Copper Co.	Wasyl Byczok	Trammer
17	July 20	" 29	do	do do	Luigi Massi	Trackman
18	" 23	Aug. 5	do	do do	P. Giovanni	Mason
19	" 22	" 27	do	do do	Geo. Ciecunescul	Trammer
20	" 26	Nov. 18	do	do do	Luigi Mascara	do
21	Aug. 2	" 22	No. 2	do do	Jack Maki	Trammer
22	" 4	Aug. 26	Creighton	do do	Nickolai Murtain	Drill runner
23	" 9	" 20	do	do do	Paul L. Simpson	Trammer boss
24	" 17	" 26	do	do do	Daniel Wink	Fitter
25	" 17	Sept. 17	do	do do	Steve Collaska	Drill helper
26	" 19	" 6	No. 3	do do	Yalmer Yansen	do
27	" 23	" 6	Creighton	do do	Eno Erickson	Scaler
28	" 26	" 4	do	do do	P. Virginio	Trammer
29	" 26	" 17	do	do do	Alex. Gidech	do
30	" 26	Oct. 7	do	do do	Ivan Michiloff	do
31	" 30	" 4	do	do do	Radi Nachoff	do
32	Aug. 31	Sept. 23	do	do do	S. Rihikienan	Drill helper
33	Sept. 4	" 12	No. 2	do do	August Wirtanen	do
34	" 4	" 12	do	do do	Nestor Haninen	Trammer
35	" 6	" 19	do	do do	Matti Syjala	do
36	" 7	" 17	Creighton	do do	John Harjie	Sledger
37	" 8	Oct. 20	No. 3	do do	F. Marashdanen	Deckman
38	" 10	Dec. 3	Creighton	do do	James Tuomi	Drill helper
39	" 13	Oct. 7	do	do do	Wm. Thompson	Timberman
40	" 15	" 28	No. 3	do do	Henry Kary	Drill helper
41	" 20	" 8	Creighton	do do	Domitro Mazur	Trammer
42	" 28	" 29	do	do do	Wm. Niemi	Scaler
43	Oct. 2	" 16	Crean Hill	do do	Myke Kivonick	Drill helper
44	" 4	Jan. 2	No. 2	do do	M. Lorenso	Trammer
45	" 5	Mar. 17	Crean Hill	do do	Aleck Alksa	Drill runner
46	" 7	Oct. 17	Creighton	do do	T. Zalboy	Trammer
47	" 9	Nov. 7	do	do do	J. Beganick	Timberman

in or About the Mines, 1912

Nationality of Injured.	Age.	Married or single	Below ground.	Above ground.	Nature and Cause of Accident.
English speaking	40	M	1	....	Hands burned and face lacerated, through an explosion, caused by drilling into missed hole.
German	45	M	1	....	Lost sight of both eyes, through explosion, caused by picking into dynamite in loose rock.
English speaking			....	1	Fractured left leg by falling from truss to ground, a distance of 18 feet.
do do			1	....	Nose broken by drill breaking.
do do			1	....	Arm broken, through being hit by falling ground.
do do			1	....	Leg broken, through slipping on rock.
do do			....	1	Caught and lacerated hand in revolving screen.
do do			1	....	Scalp wound and bruises, caused by falling rock.
do do			....	1	Fell off ladder and injured scalp and tongue.
Italian			1	....	Head cut and bruised, caused by rock falling from chute.
Polander			1	....	Fracture of leg, caused by loose rock rolling down stope.
English speaking			....	1	Fell from frame work of building, and fractured left shoulder.
do do	40	M	1	....	Fell down ladder-way from stope and broke both ankles.
Polander	45	M	....	1	Broke rib by falling on piece of rock.
English speaking	32	S	....	1	Fell from staging and bruised hip.
Russian			1	....	Fractured leg, through being struck by piece of ore rolling down ore pile.
Italian	24	M	....	1	Leg bruised by piece of blasted rock.
do	25	S	....	1	Drilled into conduit carrying 550-volt power line, and burned foot, leg and face.
Polander	35	S	1	....	While dumping ore into chute, car fell back on knee and displaced knee cap.
Italian	35	S	....	1	Fractured leg by being caught between skip and bar.
Finlander	28	S	1	....	Piece of ore fell from chute and fractured leg.
Roumanian	....	M	1	....	Pinched fingers between tripod and piece of ore.
English speaking	23	S	1	....	Small piece of ore fell from chute and cut face.
do do	61	M	....	1	Fell from top of air receiver and hurt back.
Polander	26	S	1	....	Foot bruised from falling rock.
Finlander	32	S	1	....	Pinched fingers between cable and pulley.
do	25	S	1	....	Leg cut by scaling bar.
Italian	23	S	1	....	Piece of ore fell from car, and bruised knee.
Polander	26	S	1	....	Loose piece of rock rolled on foot.
do	23	S	1	....	While dumping car, it fell back and injured ankle.
Bulgarian	30	M	1	....	Hips bruised, through being jammed between car and side of drift.
Finlander	30	S	1	....	Eye cut by piece of steel from drill.
do	24	S	1	....	Head cut by falling rock.
do	23	S	1	....	Piece of rock struck eye while sledging.
do	32	S	1	....	While dumping bucket, piece of rock crushed thumb.
do	50	M	1	....	Fell while running from sand blast, and bruised knee.
Polander	23	S	....	1	Fell while dumping bucket, and sprained foot.
Finlander	36	S	1	....	Fell over piece of timber, and fractured leg.
English speaking	40	S	1	....	Eye injured by piece of rock from hammer drill.
Finlander	35	S	1	....	Leg cut by falling rock while scaling.
Polander	24	S	1	....	Hand crushed between two cars.
Finlander	35	S	1	....	Detonating cap exploded in hand, and blew off three fingers.
Polander	30	S	1	....	Foot bruised by loose rock rolling on it.
Italian	22	S	1	....	Fell about ten feet in ladder-way and broke wrist.
Finlander	27	S	1	....	Eye cut by piece of steel flying from hammer.
Polander	21	S	1	....	Foot sprained by car wheel running over it.
do	25	S	1	....	Fell about twenty feet in shaft, scratched leg and blood poison set in.

Table of Non-Fatal Accidents

Number.	Date of Accident.	Date of Recovery.	Name of Mine.	Name of Owner.	Name of Injured.	Occupation of Injured.
48	Oct. 11	Oct. 28	Creighton ..	Canadian Copper Co.	F. Babatto	Trammer ....
49	'' 14	Nov. 1	do ...	do do	V. Pietro	Pumpman ....
50	'' 23	'' 5	No. 2	do do	V. Walanin	Trammer ....
51	'' 24	'' 8	No. 3	do do	K. Kowista	Drill helper ..
52	'' 26	'' 26	Creighton ...	do do	Geo. Typa	do ..
53	'' 26	'' 6	do ...	do do	Ivan Station	Trammer ....
54	'' 26	'' 5	No. 2	do do	E. Basa	do ....
55	'' 27	'' 7	No. 3	do do	A. Daniels	Iron worker .
56	'' 28	'' 7	Creighton ...	do do	Ilia Barson	Trammer ....
	'' 28	'' 19	do ...	do do	A. Stepanink ...	do ....
57	Nov. 1	Mar. 19	do ...	do do	S. Sydanman ...	Drill runner .
58	'' 2	Nov. 12	do ...	do do	W. Gorvilink	Trammer ....
59	'' 4	'' 18	Crean Hill ...	do do	P. Cessario	do ....
60	'' 4	'' 27	Creighton ...	do do	D. Constantino .	do ....
61	'' 4	'' 25	No. 2	do do	A. Kaktaken	do ....
62	'' 11	Dec. 9	Creighton ...	do do	Arthur Kane ...	Trammer boss
63	'' 11	Nov. 25	No. 2	do do	A. Kantulin	Trammer ....
64	'' 12	Dec. 9	No. 3	do do	Herman Rico ...	Drill helper .
65	'' 14	'' 11	do	do do	Chas. Duncan ..	Laborer ......
	'' 14	Jan. 2	do	do do	Dan. Kelly	Tile-layer.....
	'' 14	'' 1	do	do do	A. Tukowsky ...	Laborer ......
66	'' 19	Dec. 3	Creighton	do do	Wm. Thompson..	Timberman ..
67	'' 20	Jan. 2	do	do do	Karl Bassil	Drill runner..
68	'' 22	Dec. 11	do	do do	Matt. Niemi	Trammer ....
69	'' 26	'' 5	do	do do	John Drochim ..	do ....
70	'' 28	Jan. 2	do	do do	Joe Carbon	Straw boss ..
71	'' 26	Dec. 20	do	do do	Josie Genistan ..	Trammer ....
72	'' 30	Jan. 5	Crean Hill ...	do do	A. Ojanpera	Drill runner..
73	Dec. 6	'' 2	Creighton	do do	Oscar Ranta	do ..
74	'' 6	Dec. 23	do	do do	Geo. Mahoney ...	Carpenter ....
75	'' 7	Jan. 1	do	do do	Sam. Hantanen..	Drill helper ..
76	'' 13	'' 3	do	do do	Jose Oliver	Trammer ....
77	'' 13	'' 3	do	do do	Geo. Malincing ..	do ....
78	'' 16	'' 4	do	do do	Autti Haiska ..	Drill runner ..
79	'' 28	'' 27	do	do do	Ivan Station	Trammer ....
80	'' 30	'' 21	do	do do	Louis Perito	do ....
81	June 13	July 24	Cobalt Lake ..	Cobalt Lake Mining Co.	S. Fryarczuk ...	do ....
82	Dec. 26	Jan. 15	do ..	do do	Walter Paul	Timberman ..
83	Mar. 22	Apr. 20	Colonial	Colonial Mining Co.	Chas. Moon	Drill runner ..
84	May 14	May 23	do	do do	N. Richards	Hoistman ....
85	Sept. 28	Oct 9	do	do do	P. Subach	Drill helper ..
86	Nov. 22	Nov. 30	do	do do	M. Bennets	Drill runner ..
87	Apr. 1	Apr. 15	Coniagas	Coniagas Mines, Ltd.	R. Kanerva	Trammer ....
88	'' 27	May 6	do	do do	W. Barker	do ....
89	May 21	June 3	do	do do	John Garland ...	Skip tender ..
90	'' 22	'' 17	do	do do	Sam. Thomas ...	Drill runner ..
91	Dec. 11	Jan. 23	Crown Gypsum	Crown Gypsum Co..	Geo. Mortimer ..	Trammer ....
92	July 23	Aug. 10	Crown Reserve	Crown Reserve Mining Co.	Tom Dinnenon ..	Timberman ..
93	Dec. 28	Feb. 3	Henderson ...	Cross and Wellington	Thos. Birkett ...	Drill runner .
94	May 10	July 19	Dome	Dome Mines, Ltd...	Donald Kehoe ..	Millman .....
95	June 27	'' 12	do	do do ..	John Cleversley..	do .....
96	July 3	'' 22	do	do do ..	John Stevenson..	do .....

in or about the Mines, 1912—Continued.

Nationality of Injured.	Age.	Married or single	Below ground.	Above ground.	Nature and Cause of Accident.
Italian	33	M	1	....	Jammed arm between piece of ore and car.
do	35	M	1	....	Hand caught by car while dumping.
Finlander	21	S	1	....	Hand jammed between ore and car.
do	33	S	....	1	Stepped on nail, and injured foot.
Roumanian	21	S	1	....	Fell down stope, and sprained ankle.
Polander	23	S	1	....	Fell into car, and piece of ore from chute struck him in back.
Italian	21	S	1	....	Piece of ore fell on hand, and crushed fingers.
English speaking	27	S	....	1	Stepped on compressor foundation, and sprained ankle.
Polander	31	S	1	....	Head cut by explosion in ore pile.
do	25	S	1	....	Face cut and eye injured by explosion in ore pile.
Finlander	25	S	1	....	Struck on elbow by rock thrown by blast.
Polander	32	S	1	....	When dumping car, it fell back, and bruised finger.
Italian	19	S	1	....	Struck in eye by piece of rock while sledging.
do	47	S	1	....	Jammed thumb between two timbers.
Finlander	23	S	1	....	Fell about ten feet from ladders, injuring side and ankle.
English speaking	30	S	1	....	Jammed finger between car and air line.
Finlander	22	S	1	....	Crushed finger between car and piece of ore.
do	35	M	1	....	Jammed finger while taking timber out of shaft.
English speaking	21	S	....	1	Pole supporting scaffold broke, allowing men to fall to floor.
do do	32	S	....	1	
Polander	21	S	....	1	
English speaking	39	M	1	....	Cut kneecap with axe.
Polander	36	S	1	....	Arm bruised through premature explosion while sand-blasting.
Finlander	40	S	1	....	Tramcar ran over foot.
Polander	21	S	1	....	Face and eye burned by removing bell from carbide lamp and igniting gas.
Italian	45	M	....	1	Caught by trommel and broke two ribs.
Spaniard	23	S	1	....	Jammed hand between two pieces of ore.
Finlander	28	M	1	....	Finger caught between steel and rock.
do	30	S	1	....	Drilled into explosive in old hole and sight of one eye destroyed.
English speaking	32	M	....	1	Fell on spike and cut hand.
Finlander	22	S	1	....	Wheel of skip ran over foot.
Spaniard	38	M	1	....	Nose broken by falling rock.
Polander	23	M	1	....	While pulling timber out of chute it fell on leg.
Finlander	27	S	1	....	Finger caught between arm and collar of bar.
Polander	23	S	1	....	Finger struck by rock falling from chute.
Spaniard	27	S	1	....	Leg jammed between two pieces of rock.
Polander	25	S	1	....	Bucket upset off truck and fractured leg.
English speaking	46	M	1	....	Struck by falling ground and bruised back and shoulder.
do do	....	....	1	....	Fell down winze and sprained back.
do do	24	S	....	1	Valve blew off and injured eyes.
German	50	M	1	....	Rib broken by hammer falling down shaft.
English speaking	....	....	1	....	Staging broke and bruised back.
Finlander	30	....	1	....	Caught hand between car and chute and jammed fingers.
English speaking	....	....	1	....	Bruised by falling into chute.
do do	....	....	1	....	Elbow dislocated by rock falling down shaft.
do do	....	....	1	....	Crushed thumb in drill.
do do	30	....	1	....	Caught ankle between car and rock.
do do	....	....	1	....	Falling rock dislocated shoulder.
do do	55	M	1	....	Left leg broken through being jammed between timber and falling ore.
do do	26	M	....	1	Arm and shoulder caught by conveyor belt.
do do	21	S	....	1	Arm caught by conveyor belt.
do do	37	M	....	1	Broke arm in mill machinery.

Table of Non-Fatal Accidents

Number	Date of Accident.		Date of Recovery.		Name of Mine.	Name of Owner.	Name of Injured.	Occupation of Injured.
97	Oct.	15	Dec.	28	Dome	Dome Mines, Ltd.	Frank Trunk	Fireman
98	"	17	Nov.	13	do	do do	John Sarri	Drill runner
99	Nov.	8	Dec.	8	do	do do	Geo. Makowe	Laborer
100	"	27	Jan.	6	do	do do	Thos. Lockstone.	Trammer boss
101	"	28	Dec.	11	do	do do	Fred. Trudell	Laborer
102	Dec.	13	"	26	do	do do	D. Jolicoeur	Carpenter
103	"	7	"	24	Dome Lake	Dome Lake Mines, Ltd.	Frank Dunne	do
104	Jan.	30	Mar.	16	Kerr Lake	Kerr Lake Mining Co.	Wm. Johns	Sampler
105	Mar.	8	"	15	do	do do	F. Rondska	Trammer
106	Sept.	14	Oct.	10	do	do do	N. Blakey	Drill runner
107	Oct.	4	"	15	do	do do	R. Clattenburg	Drill helper
108	Nov.	29	Feb.	1	do	do do	John Dubowsky	Trammer
109	Feb.	24	Mar.	19	Lawson	La Rose Mines, Ltd.	P. Beranda	do
110	Mar.	9	"	19	La Rose	do do	M. Kolyjczuk	Drill helper
111	April	5	April	14	do	do do	H. Moskalyh	do
112	July	10	Sept.	1	do	do do	L. Gignac	Trammer
113	Nov.	30	Jan.	20	do	do do	J. McIsaac	Drill runner
114	Jan.	5	"	18	Helen	Lake Superior Power Co.	Alex. Steel	Electrician
115	"	18	"	29	do	do do	M. Paiogeion	Trammer
116	"	28	Feb.	5	Magpie	do do	Kusti Kangas	do
117	Feb.	6	"	23	Helen	do do	C. Zucato	do
118	"	8	"	24	do	do do	L. Boldovin	do
119	"	27	Mar.	11	do	do do	T. Kaularic	do
120	"	28	"	19	do	do do	G. Grollo	do
121	Mar.	1	"	11	do	do do	G. Falinski	do
122	April	11	April	22	do	do do	A. Borese	do
123	"	18	"	28	do	do do	J. Petyk	do
124	"	24	July	15	do	do do	Thos. Richardson	Laborer
125	May	7	May	21	do	do do	J. Macios	Trammer
126	"	7	"	20	do	do do	G. Zanitti	do
127	"	10	"	20	do	do do	I. Pecile	do
128	"	19	"	27	do	do do	A. Pegoraro	do
129	"	20	"	29	do	do do	G. Pecile	do
130	"	21	June	17	do	do do	A. Ferrari	do
131	"	21	"	5	do	do do	C. Duclos	do
132	"	28	"	17	do	do do	M. Dupont	Drill runner
133	"	29	July	20	do	do do	V. Morriatt	Trammer
134	"	31	"	3	do	do do	G. Basso	Drill runner
135	June	3	June	26	do	do do	E. Waara	do
136	"	12	"	26	do	do do	A. Fabbro	Trammer
137	"	18	"	26	do	do do	V. Zeraldo	do
138	"	24	July	8	do	do do	P. Buchan	Carpenter
139	July	16	"	31	do	do do	M. Pavolitch	Trammer
140	"	18	Aug.	6	do	do do	L. Presello	do
141	"	20	"	1	do	do do	A. Pegararo	do
142	Aug.	1	Sept.	5	do	do do	V. Anic	do
143	"	29	"	23	do	do do	G. Boika	do
144	Sept.	6	"	16	do	do do	J. De Meio	Drill runner
145	Oct.	1	Oct.	14	do	do do	J. De Diana	Skip tender
146	"	5	"	15	do	do do	A. Laguna	Drill runner
147	"	5	"	14	do	do do	T. Meller	Trammer
148	"	25	Nov.	4	do	do do	A. Koski	do
149	"	30	"	11	do	do do	O. Peterson	Laborer
150	"	25	"	10	do	do do	J. Kriztof	Trammer
151	"	31	"	12	do	do do	P. Milaknoja	do
152	Feb.	26	Mar.	11	do	do do	U. Skibo	do
153	Mar.	20	April	1	Magpie	Lake Superior Iron and Steel Co	A. Foucault	Carpenter
154	May	2	May	31	do	do do	J. Calligoro	Laborer
155	"	10	"	20	do	do do	D. Vezmar	Drill runner

in or about the Mines, 1912.—Continued.

Nationality of Injured.	Age.	Married or single	Below ground.	Above ground.	Nature and Cause of Accident.
Bohemian	28	S	....	1	Boiler tube exploded and burned body.
Finlander	27	S	1	....	Leg struck by falling board.
Austrian	23	S	1	....	Tramcar ran over leg.
English speaking	26	S	1	....	Car ran over foot.
do do	33	....	1	....	Car ran over foot.
do do	22	M	....	1	Slipped on ice and dislocated shoulder.
do do	38	M	....	1	Fell off scaffold and injured hip.
do do	20	S	1	....	Right foot broken by falling rock.
Polander	....	....	1	....	Hammer drill fell from staging and bruised back.
English speaking	....	....	1	....	Fell fifteen feet with staging and bruised head and shoulder.
do do	22	S	1	....	Dirt blown into eyes by blowpipe.
Russian	23	M	1	....	Jammed thumb between two pieces of rock.
Austrian	22	S	1	....	Slipped on turn sheet and displaced kneecap.
Polander	26	M	1	....	Fell about ten feet and bruised body.
do	....	....	1	....	Scalp wound from falling rock.
Austrian	50	M	1	....	Rock fell from chute and bruised foot.
English speaking	....	....	1	....	Struck foot with hammer.
do do	47	M	....	1	Caught by trommel and injured thigh.
Italian	21	S	1	....	Fell down ladder ten feet and bruised knee.
Finlander	21	S	....	1	Tramcar ran over foot.
Italian	24	S	1	....	Caught little finger between car and door.
do	27	M	1	....	Toe crushed by falling ore.
do	36	M	1	....	Leg bruised by ore falling from shovel.
do	40	M	1	....	Caught finger between car and timber.
Polander	27	....	1	....	Piece of ore rolled on foot.
Italian	30	M	1	....	Wrist jammed between car and timber.
Polander	25	S	....	1	Caught little finger between car and truck.
English speaking	35	M	....	1	Hand cut with axe.
Italian	25	S	1	....	Fingers crushed between car and piece of ore.
do	37	M	1	....	Finger caught between car and truck.
do	26	S	1	....	Finger caught between car and timber of drift.
do	31	M	1	....	Crushed shoulder between car and timber of drift.
do	28	....	1	....	Finger caught between car and timber of drift.
do	28	....	1	....	Fingers crushed between car and piece of ore.
do	28	....	1	....	Fell 55 feet down raise, and injured right arm.
English speaking	31	M	1	....	Crushed thumb in drill.
do do	35	M	1	....	Finger struck by ore falling from car.
Italian	30	....	1	....	Cut under eye by ore falling down raise.
Polander	26	....	1	....	Scalp cut through premature blast.
Italian	23	S	1	....	Caught finger between car and piece of rock.
do	42	M	1	....	Struck in eye by piece of ore.
English speaking	41	M	....	1	Slipped on plank, and injured ankle.
Polander	25	S	1	....	Caught finger between car and chute.
Italian	19	S	1	....	Finger cut by ore falling down chute.
do	32	M	1	....	Finger pinched between pipe and car.
do	23	S	1	....	Caught finger between car and chute.
Finlander	33	M	1	....	Legs bruised by ore falling from chute.
Italian	21	S	1	....	Fell down raise, and injured scalp and legs.
do	32	M	1	....	Strained back lifting on car.
do	27	....	1	....	Hand cut by piece of rock.
do	31	....	1	....	Struck on hip by ore falling from chute.
Polander	33	....	1	....	Caught wrist between car and timber.
Swede	48	M	....	1	Ankle injured while working on skip.
Polander	33	....	1	....	Caught wrist between car and timber.
Russian	23	....	1	....	Car ran over foot, and injured ankle.
Italian	21	....	....	1	Slipped on step, and injured back.
English speaking	19	S	....	1	Axe slipped, and cut leg.
Italian	28	....	....	1	Fell 14 feet from trestle, and fractured collar bone.
Russian	22	....	1	....	Struck on hand by sledge.

Table of Non-Fatal Accidents

Number.	Date of Accident.	Date of Recovery.	Name of Mine.	Name of Owner.	Name of Injured.	Occupation of Injured.
156	May 31	June 11	Magpie	Lake Superior Iron & Steel Co	Z. Savage	Carpenter
157	July 23	Aug. 8	do	do do	M. Prokonectz	Deckman
158	" 27	Sept. 9	do	do do	A. De Bon	Drill runner
159	Aug. 9	Aug. 20	do	do do	O. Lahtimer	Trammer
160	Sept. 2	Oct. 7	do	do do	V. Boni	Iron worker
161	" 10	" 22	do	do do	A. De Mario	do do
162	" 19	Sept. 27	do	do do	J. Waitoskey	Drill runner
163	Nov. 11	Nov. 25	do	do do	J. Vukovick	Trammer
164	" 28	Dec. 16	do	do do	A. Boni	Drill runner
165	July 24	Aug. 21	Mann	Mann Mines, Ltd.	Tom Wilson	Fireman
166	Nov. 4	Feb. 6	McEnaney	Crown Reserve Mg. Co.	Dan McMillan	Drill runner
167	July 19	Oct. 19	McIntyre	McIntyre Porcupine Gold Mines, Ltd.	J. G. Harris	Superintend't
168	Aug. 17	Nov. 4	McKinley-Darragh	McKinley - Darragh-Savage Mines, Ltd.	Joe Covosh	Drill runner
169	Nov. 2		do do	do do	G. Demianink	Laborer
170	May 29	June 12	Garson	Mond Nickel Co.	Geo. Mortimer	Drill runner
171	June 11	July 30	Frood Extension	do do	Steve Lateski	do
172	July 2	Aug. 9	do do	do do	A. Ryhanen	Timberman
173	Oct. 22	Feb. 8	Victoria Mine.	do do	John Crawchuck.	Skip tender
174	Dec. 27	Jan. 20	Sulphide	Nicholls Chemical Co.	Eli Derushie	Drill runner
175	May 23	June 18	Nipissing	Nipissing Mining Co.	J. Dubois	do
	" 23	July 2	do	do do	Z. Vachour	Drill helper
176	July 8	Oct. 26	do	do do	G. Fournier	Carpenter
177	" 29	Aug. 5	do	do do	H. Buglehole	Boilermaker
178	Sept. 5	Sept. 23	do	do do	G. Angelo	Laborer
179	Nov. 5	Nov. 23	do	do do	Peter Dagenais	Drill runner
180	Dec. 7		do	do do	John Linski	Drill helper
181	June 21	June 30	Concentrator	Northern Customs Concentrator, Ltd.	J. Peder	Laborer
182	Aug. 4	Sept. 4	do	do do	J. N. Monsion	Oiler
183	" 15	Aug. 24	do	do do	D. Walmsley	Carpenter
184	Dec. 3	Dec. 20	do	do do	R. Kitto	Laborer
185	Jan. 5	Perm'ly Disabled	O'Brien Mill	M. J. O'Brien	Chas. Westbrook.	Millman
186	Feb. 6	Feb. 14	O'Brien	do do	Geo. Morey	Drill helper
187	Mar. 21	Apr. 7	do	do do	Luke Arney	Drill runner
188	Nov. 30	Feb. 4	do	do do	John Shaw	do
189	July 6	July 20	Ophir	Ophir Mining Co.	M. Beniski	Trammer
190	Nov. 11	Dec. 3	Penn Canadian	Penn Can. Mines	N. Bodak	Drill runner
191	Dec. 4		do do	do do	Fred Cox	do
192	" 23	Jan. 6	do do	do do	Ed. Billings	Millman
193	Apr. 21	May 2	Right of Way.	Right of Way Mining Co.	A. Hill	Hammerman
	" 21	June 17	do do	do do	M. Hendrickson	do
	" 21	" 17	do do	do do	J. Hill	do
	" 21	Apr. 28	do do	do do	G. Resta	do
194	Jan. 5	Jan. 12	Temiskaming	Temiskaming Mining Co.	C. Davidson	Trammer
195	May 21	July 15	do	do do	C. Flynn	Drill runner
196	June 28	" 9	do	do do	H. Williamson	do

in or about the Mines, 1912—Continued

Nationality of Injured.	Age.	Married or single.	Below ground.	Above ground.	Nature and Cause of Accident.
English speaking	45	....	....	1	Toe crushed by timber rolling on it.
Polander	....	....	....	1	Fingers caught and crushed while dumping bucket.
Italian	24	....	....	1	Tripod fell on leg.
Finlander	24	S	....	1	Fell down dump with car, and injured scalp.
Italian	29	M	....	1	Caught toe between sheave wheel and cable.
do	23	....	....	1	Struck on leg by broken end of chain.
Russian	24	....	1	....	Struck on shoulder by steel falling from sling.
do	24	....	1	....	Cut finger with sharp edge of shovel.
Italian	24	....	1	....	Caught finger between drill chuck and rock.
English speaking	45	M	....	1	Broken rib and scalp wound, through being struck by bar while starting compressor.
do do	....	....	1	....	Leg broken by falling rock.
do do	34	M	1	....	Knee cap and ankle broken, through chairs on cage catching in timber.
Hungarian	34	M	1	....	Struck on ankle by ground rolling down stope.
Roumanian	35	....	....	1	Coil of cable rolled on foot.
English speaking	....	....	1	....	Fell about 8 feet from ladder, and broke two ribs.
Polander	....	....	1	....	Struck on head by rock falling from timber in shaft.
Finlander	28	....	1	....	Slipped off timbers while timbering shaft, and injured head.
do	....	....	1	....	Riding with steel in cage, when steel caught and broke leg, causing subsequent amputation.
English speaking	39	M	1	....	Piece of timber fell on toe.
do do	23	....	1	..	Drilled into old hole, causing an explosion and injured legs.
do do	29	....	1	..	
do do	....	....	....	1	Stepped on pinch bar and fractured ankle.
do do	35	M	....	1	Ladder fell against head.
Italian	22	S	....	1	Thumb cut by crosscut saw.
English speaking	....	....	1	....	Badly bruised through falling in stope.
Finlander	32	M	1	....	Struck on hip and spine by flying rock from blast.
English speaking	....	....	....	1	Roller under heavy machinery passed over toe.
do do	35	M	....	1	Lost sight of one eye through being struck by steel.
do do	....	....	....	1	Cut right foot with axe.
do do	37	M	....	1	Fell off runway to ground and fractured skull.
do do	28	S	....	1	Burned by caustic soda and lost sight of both eyes.
do do	28	S	1	....	Struck by piece of rock on cheek.
do do	....	....	1	....	Fell from timber to rock pile and injured side.
do do	....	....	1	....	Piece of steel from drill struck eye.
Polander	....	....	1	....	Skid fell and injured left shoulder.
do	27	....	1	....	Caught between cage and timber and broke three ribs.
English speaking	....	....	1	....	Struck by falling rock and arm broken.
do	....	....	....	1	Thrown while shifting belt and injured head.
Finlander	....	....	1	..	Drilled into missed hole containing explosives.
do	....	....	1	..	
do	....	....	1	..	
do	....	....	1	..	
English speaking	....	....	1	....	Nose broken by handle of windlass.
do	....	....	1	....	Fell from temporary platform, and broke ankle.
do	....	....	1	....	Cage dropped short distance, and sprained knee.

Table of Non-Fatal Accidents

Number.	Date of Accident.	Date of Recovery.	Name of Mine.	Name of Owner	Name of Injured.	Occupation of Injured.
197	April 22	May 10	Trethewey ...	Trethewey Mg. Co...	J. Wells	Trammer ....
198	" 27	" 13	do ...	do do	M. Slywczuk	Drill runner .
199	June 11	July 3	do ...	do do	M. Donovan	do ..
200	" 14	Dec. 14	do ...	do do	D. McA. Newlands	Laborer ......
201	Aug. 21	Oct. 14	do ...	do do	I. G. Dean.......	Master mechanic
202	Sept. 23	Jan. 15	do ...	do do	M. Ywanozuk....	Trammer ....
203	Nov. 4	Nov. 10	do ...	do do	A. McAskill	Drill runner .
	" 4	Dec. 13	do ...	do do	F. Dwyer	Drill helper ..
204	" 11	Nov. 27	do ...	do do	S. Dublik	Drill runner .
205	Dec. 7	Jan. 9	do ...	do do	J. Chamberlain .	Carpenter ....
206	Mar. 14	No ret'rn	Vipond	Vipond Porcupine Mines, Ltd.	J. Campbell	Drill runner .
207	June 10	Sept. 10	Wettlaufer ...	Wettlauffer Lorrain Silver Mines, Ltd..	Hugh R. Mill ...	Millman .....
208	" 29	July 12	do ...	do do	Alex Cayo	Teamster ....
					Total.......	....

in or about the Mines, 1912—Concluded

Nationality of Injured.	Age.	Married or single	Below ground.	Above ground.	Nature and Cause of Accident.
English speaking	26	S	1	....	Fell down stope into chute, and broke two ribs.
Austrian	23	S	1	....	Fell from staging, and cut head.
English speaking	26	S	1	....	Caught hand between timber and bucket.
do	43	M	....	1	Fell twelve feet, and fractured spine.
do	32	M	....	1	Caught knee in elevator gears.
Polander	26	S	1	....	Fell off ladder in shaft, and broke leg.
English speaking	30	S	1	..	Drilled into old hole that had been blasted.
do	24	S	1	..	
Polander	....	....	1	....	Light ignited gas from carbide can, and burned eyes.
English speaking	25	M	....	1	Left thumb cut off by saw.
do	45	M	1	....	Drilled into missed hole; explosion followed, and caused loss of sight of one eye.
do	26	S	....	1	Caught hand in elevator gear.
do	50	M	....	1	Kicked on head by horse.
....	....	....	160	56	

Accidents at Metallurgical Works

The metallurgical works which come under the provisions of the Mining Act of Ontario include blast furnaces, copper-nickel smelters and converter plants, and silver smelters. At such works during 1912 there were 10 workmen killed, compared with 9 in 1911, and 122 injured.

Blast Furnaces

At blast furnaces 7 men lost their lives, compared with 2 in 1911. Four of these men were asphyxiated by blast furnace gas. This gas contains from 20 to 25 per cent. carbon monoxide, a very deadly poison, and it is consequently necessary that exceptional care should be taken that the leakage of the gas around the furnace should be reduced to a minimum. One of the men lost his life in the boiler-room through an excessive leakage of gas from the gas main. Two were asphyxiated while emptying a gas leg of flue dust. These men were working practically in the open, and it is difficult to ascertain how they were overcome. The other man lost his life in a gas-washing house. In this building there is always a certain amount of gas, which is brought over in the water used in washing the gas, and it was a rule that one man should never go into this building alone. Owing to the violation of this rule, the workman was overcome by the gas and was not found until it was too late to resuscitate him. It is advisable to have around the blast furnace an oxygen reviving apparatus for treating workmen overcome by gas.

One man was killed through the breaking of a 70-lb. steel rail which supported a scaffold, causing his fall to the ground, where he was struck by a piece of material falling with the scaffold. Another man was electrocuted while engaged in washing out a boiler. He had an extension cord from the 110-volt lighting circuit, and, while adjusting the wire guard for the lamp, received a shock which caused his death. Accidents of this nature from so low a voltage are rare, but their occurrence shows that care must be taken to have low-voltage wires properly insulated. The remaining blast furnace accident occurred while the workmen were taking out the old lining of the furnace preparatory to relining it. Part of the old lining caved, causing one of the workmen to fall into the furnace, where he received burns and other injuries which caused his death. Sufficient care was not taken in this case to have the workmen properly protected, so that in case of an accident of this nature, it would be impossible to fall into the furnace.

In addition to the fatalities in the blast furnaces there were 51 workmen injured. Twenty-four of these injuries were burns received while working around the furnace, due generally speaking to the hot slag or iron. The Act requires suitable shields or appliances to protect the workmen. Sufficient attention is not paid by the management to this provision. Men are allowed to work around the furnace improperly clothed for work of this nature.

Copper-Nickel Smelters and Converter Plants

Three men lost their lives while employed at copper-nickel smelters and converter plants in 1912, compared with 6 in the preceding year. One of these men was struck by a train while walking along the track on his way home from work. Another man was crushed by the rabbles in the drying plant for fines of the reverberatory furnace. The workman must have got up on top of the dryer while the machinery was in motion and was caught by the return rabble. The other workman was struck by a piece of falling board while engaged on repair work in the smelter building. A scaffold had been erected, and, owing to one end of the supporting timber not being tied, the plank fell.

In addition to the 3 fatalities there were 65 workmen who received injuries which incapacitated them for over 7 days. Of these injuries 11 were fractures, and there were three cases of permanent disability, of differing degrees of severity.

Silver Smelters

There were no fatal accidents at silver smelters during 1912. Six non-fatal accidents were reported during the year. Of these, one was serious and involved the fracture of three ribs, due to being struck by train.

The specific occupation in the works of the men who were killed, and their nationality, are shown in the following table:

Occupation.	English speaking.	French.	Swede.	Polander.	Italian.	Total.
Water tender	2	1				3
Straw boss				2		2
Laborer	2					2
Rigger			1			1
Electrician	1					1
Cinderman					1	1
Total	5	1	1	2	1	10

The ages of the men killed at the metallurgical works were as follows:—

17–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	Total.
0	2	3	2	1	0	1	1	10

Cause and Place of Fatalities at Metallurgical Works

		1912		1911
Blast Furnaces:—				
Asphyxiation from furnace gas	4		0	
Breaking of scaffold	1		0	
Electrocution	1		0	
Lining of furnace falling	1		0	
Run over by yard engine	0		1	
Struck by falling brick while relining furnace	0		1	
	——	7	—	2
Copper-Nickel Smelters and Converter Plants:—				
Struck by train	1		0	
Crushed by rabbles	1		0	
Struck by falling plank	1		0	
Explosion in settler	0		1	
Crushed between cars	0		1	
Struck by piece of slag falling from hood	0		1	
Falling through roof of building	0		1	
Falling of converter hood	0		1	
Electrocuted in power house	0		1	
	——	3	—	6
Silver Smelters:—				
Falling from scaffold		0		1
Total		10		9

Cause and Place of Non-Fatal Accidents at Metallurgical Works

The following schedule shows the cause and place of the non-fatal accidents in 1912 at the metallurgical works, and the number injured:—

Blast Furnaces:—		
Burned	24	
Falling objects	6	
Caught in machinery	4	
Falling from elevated places	3	
Burned by electric wires	3	
Run down by cars	2	
Gassed	1	
Miscellaneous	8	
		51
Copper-Nickel Smelters and Converter Plants:—		
Falling from elevated places	13	
Burned	12	
Crushed between two objects	11	
Run into by cars	9	
Struck by falling objects	6	
Caught in machinery	4	
Burned by electric wires	1	
Miscellaneous	9	
		65
Silver Smelters:—		
Struck by falling objects	3	
Burned	1	
Run into by cars	1	
Caught by machinery	1	
		6
Total		122

The specific occupation of the men in the metallurgical works who were injured, and their nationality, are shown in the following table:—

Occupation.	English speaking.	Italian.	Polander.	Finlander.	Bulgarian.	Austrian.	Russian.	French.	Not known.	Total.
Laborer	3	18	11	1	3	2	2	1	5	46
Furnace helper	......	4	1	......	......	1	......	......	5	11
Brakeman	2	1	2	......	......	......	......	......	1	6
Keeper	......	2	1	......	......	......	......	......	3	6
Fitter	5	2	......	......	......	......	......	......	......	7
Tapper	......	3	2	......	......	......	......	......	......	5
Baleman	......	1	4	......	......	......	......	......	......	5
Oiler	1	2	......	1	......	......	......	......	......	4
Electrician	3	......	......	......	......	......	......	......	......	3
Conductor	2	......	......	......	......	......	......	......	1	3
Tapper's helper	2	......	1	......	......	......	......	......	......	3
Carpenter	1	2	......	......	......	......	......	......	......	3
Foreman	2	......	......	......	......	......	......	......	......	2
Boilermaker's helper	1	1	......	......	......	......	......	......	......	2
Engineer	2	......	......	......	......	......	......	......	......	2
Blower	2	......	......	......	......	......	......	......	......	2
Matte loader	......	1	......	......	......	......	......	......	......	1
Water boy	......	1	......	......	......	......	......	......	......	1
Cage tender	......	1	......	......	......	......	......	......	......	1
Lineman	......	......	......	1	......	......	......	......	......	1
Pattern maker	1	......	......	......	......	......	......	......	......	1
Rigger	......	......	......	1	......	......	......	......	......	1
Repair man	1	......	......	......	......	......	......	......	......	1
Millwright	1	......	......	......	......	......	......	......	......	1
Stove tender	1	......	......	......	......	......	......	......	......	1
Machinist	1	......	......	......	......	......	......	......	......	1
Water tender	1	......	......	......	......	......	......	......	......	1
Master mechanic	1	......	......	......	......	......	......	......	......	1
Total	33	39	22	4	3	3	2	1	15	122

The ages of the men injured at the metallurgical works were as follows:—

17 to 20	21 to 25	26 to 30	31 to 35	36 to 40	41 to 45	46 to 50	60–65	Unknown.	Total.
17	30	25	25	7	4	2	1	11	122

Table of Fatal Accidents at

Number.	Date.	Name of Works.	Name of Owner.	Name of Injured.	Occupation of injured.
	1912				
1	April 27..	Blast Furnace..	Algoma Steel Company..	John Sharpe	Water tender
2	July 3..	" ..	" " ..	Albert Auger	"
3	Oct. 22..	" ..	" " ..	Oscar Kleberg......	Rigger ......
4	Nov. 14..	" ..	" "	Geo. Zink .... Geo. Smith........	Laborer ..... " ....
5	Dec. 11..	" ..	" " ..	Geo. Simpson	Water tender.
6	May 13..	Reverberatory Furnace.	Canadian Copper Co.....	Philip Lamichuck ..	Straw boss ..
7	Sept. 20..	Smelter yard ..	" " ..	Mat Dswonkowski..	" ..
8	Nov. 9..	Smelter	" " ..	E. J. Harper	Electrician ..
9	Oct. 3..	Blast Furnace..	Steel Company of Canada	Giovanni Contt.....	Cinderman ..

Metallurgical Works, 1912.

Nationality of injured.	Age.	Married or single.	Above ground.	Nature and cause of accident.
English speaking..	49	M	1	Overcome by gas in boiler house.
" ..	25	S	1	While washing out boiler received shock from 110-volt light wire.
Swede............	29	S	1	Fell from scaffold and struck on head with heavy casting.
English speaking..	55	M	1	Overcome by blast furnace gas.
" ..	35	M	1	
" ..	40	M	1	Overcome by gas while dumping seals in gas washing house.
Polander	28	M	1	Crushed by rabbles.
Polander	53	M	1	Struck by train.
English speaking..	28	S	1	Skull fractured by falling plank.
Italian	32	M	1	Brick lining of furnace fell, carrying him with it. Died Oct. 9th
Total.....	....	....	10	

Table of Non-Fatal Accidents

Number.	Date of Accident.	Date of Recovery.	Name of Works.	Name of Owner.	Name of Injured.	Occupation of Injured.
1	Jan. 17	Jan. 30	Blast furnace.	Algoma Steel Corporation	O. H. Hugill	Repairman
2	" 16	....	do	do do	L. Maccaracca	Helper
3	" 31	....	do	do do	Jon Cwiakala	Keeper
4	Feb. 15	....	do	do do	G. Pricci	Laborer
5	" 15	....	do	do do	Robt. Hill	Millwright
6	" 4	Feb. 28	do	do do	Geo. Szuba	Helper
7	" 15	" 28	do	do do	Frank Daly	Laborer
8	Jan. 15	" 6	do	do do	Albert Snienek	do
9	Mar. 16	....	do	do do	G. Dulesandro	do
10	Jan. 11	Jan. 26	do	do do	S. W. Murphy	Blower
11	Mar. 19	Mar. 27	do	do do	Geo. Paulick	Keeper
12	April 4	April 17	do	do do	Jas. Dwyer	Electrician
13	" 26	....	do	do do	Isaac Waddle	Carpenter
14	" 26	....	do	do do	T. St. George	Pipe fitter
15	May 1	....	do	do do	P. Kovinich	Helper
16	" 2	....	do	do do	Toni Tersigno	Laborer
17	" 18	....	do	do do	M. Gutcher	Conductor
18	" 24	....	do	do do	F. Knorck	Helper
19	June 16	....	do	do do	P. Wilusz	Keeper
	" 16	....	do	do do	J. Kobratka	Helper
20	" 27	July 8	do	do do	Jos. Refcha	Laborer
21	July 6	" 15	do	do do	J. L. Radcliffe	Stove tender
22	" 23	Sept. 23	do	do do	Sam Pepovitch	Laborer
23	" 26	Aug. 18	do	do do	Geo. Uremovic	Helper
24	Aug. 14	" 27	do	do do	Thos. Edgar	Machinist
25	" 15	Sept. 16	do	do do	J. Mendetta	Laborer
26	" 15	Aug. 27	do	do do	Joe Jasensky	Keeper
27	" 17	" 30	do	do do	A. Marcellari	Laborer
28	" 19	" 27	do	do do	J. Zurowinski	do
29	" 20	Sept. 17	do	do do	S. W. Murphy	Blower
30	Sept. 3	" 15	do	do do	S. Walicky	Laborer
31	" 12	Oct. 1	do	do do	J. Wenovil	Helper
32	" 12	Sept. 27	do	do do	Geo. Szuba	do
33	" 16	" 30	do	do do	T. Saverio	Oiler
34	" 22	Oct. 14	do	do do	J. Wright	do
35	" 23	" 7	do	do do	Toni Pergomet	Laborer
36	Oct. 5	" 14	do	do do	Harry Knox	Water tender.
37	" 19	Oct. 28	do	do do	G. Aleghi	Oiler
38	" 29	Nov. 9	do	do do	E. Barberesi	Helper
39	Nov. 27	Dec. 9	do	do do	C. Desrochers	Laborer
40	" 28	" 6	do	do do	M. Sandoni	do
41	Dec. 3	" 15	do	do do	Peter Korale	Helper
42	" 17	" 30	do	do do	S. Gawant	do
43	" 2	....	do	do do	G. Volpe	Keeper
44	" 24	....	do	do do	G. Calabianchi	do
45	" 29	....	do	do do	Chas. Waters	Laborer
46	Mar. 14	May 30	Smelter	Canadian Copper Co.	Peronti Pielo	Brakeman
47	May 13	July 2	do	do do	Allan Bruce	do
48	July 8	" 17	Roast yard	do do	F. Krutisck	Laborer
49	" 19	Nov. 19	Smelter	do do	Gabriel Younie	do
50	" 19	" 19	do	do do	Ubaniti Veriato	Matte loader
51	" 25	Aug. 2	do	do do	John Katynka	Brakeman
52	" 26	" 22	do	do do	Jan Rogozynsky	Baleman
53	" 29	" 12	Roast yard	do do	John Switch	Foreman
54	" 30	" 12	Smelter	do do	Robt. Bell	Electrician
55	" 30	" 8	do	do do	P. Gardullo	Laborer
56	" 31	" 14	do	do do	M. Petroski	do
57	Aug. 4	D ec 19	do	do do	F. Pietro	do
58	July 23	Aug. 12	Roast yard	do do	A. Silvester	Water boy
59	" 23	" 20	Smelter	do do	W. Firborg	Laborer
60	" 28	Nov. 13	do	do do	W. Balmforth	Boilermaker's helper

at Metallurgical Works, 1912

Number Injured.	Nature of Injury.	Cause of Accident.
1	Fingers bruised	Fingers caught between cable and sheave.
1	Burns on back and neck.	While stopping iron notch, burned by iron.
1	Burn on ankle	Drilling cinder notch.
1	Face bruised	Struck by hammer.
1	Nose broken	Struck by falling bolt.
1	Head burnt	Burned while casting iron.
1	Gassed	Overcome by blast-furnace gas.
1	Left leg burned	Leg burned by hot iron.
1	Little finger broken	Caught between hoist box and pipe.
1	Leg and back burned	Burned by hot cinder.
1	Arms burned	While flushing furnace, cinder splashed.
1	Hand burned	Burned by fuse blowing.
1	Finger crushed	Piece of ore fell on finger.
1	Hand burned	Took hold of live wire.
1	Hand and arm burned	Iron splashed on him.
1	Foot scalded	Stepped in trough of boiling water.
1	Foot crushed and toe amputated	Slipped while making coupling.
1	Foot burned	Pulling bar from cinder notch and hot cinder splashed in his boot.
1	do do	While driving bar into iron hole, iron blew out.
1	do do	
1	Shoulders burned	Burned by hot coke from iron notch.
1	Foot cut	Cut foot on bar.
1	Leg broken	Fell off platform.
1	Burns on arms and chest.	Struck by hot iron while tapping.
1	Arm bruised	Caught by armature being lowered.
1	Cut and bruised	Caught between coke car and chute.
1	Leg bruised	Struck by hammer.
1	Eyes burned	Iron exploded while shovelling on coke braize.
1	Cut on head	Struck by falling bar.
1	Two fingers crushed	Fingers caught between sheave and cable.
1	Foot burned	Iron splashed while pulling bar from iron notch.
1	Finger cut	Ball of tuyere-puller caught finger.
1	Left foot burned	Hot cinder came out through gun.
1	Fingers crushed	Oiling sheave when cable came off.
1	Right arm cut	Fell down steps into basement.
1	Face burned	Gas blew out of stove.
1	Thumb cut	Cut by axe while chopping wood.
1	Left leg bruised	Fell into pit under engine.
1	Burn on right leg	Pot of cinder exploded.
1	Burns on hands	Burned while connecting two live wires.
1	Head cut	Struck by ore falling from bridge.
1	Foot burned	Drawing bar at cinder notch.
1	Arm burned	Hot cinder splashed while casting.
1	Eye injured	Gas blew cinder into eye.
1	Burn on foot	Iron splashed while drilling tapping hole.
1	Arm scalded	Steam escaped from steam pipe.
1	Right leg fractured	Fell between charging cars.
1	Injured internally	Squeezed between post and locomotive.
1	Thumb bruised	Thumb caught between two rails.
1	Arm and side injured	Fell into coke bin.
1	Arm broken	Arm crushed under sheet of matte.
1	Face burned	Oil on shovel caught fire.
1	Neck burned	Matte splashed, burning him on neck.
1	Rib broken	Foot slipped while mounting to cab of engine.
1	Finger cut	Finger cut by foot shears.
1	Arm and shoulder injured	While raising pole, it slipped and fell on him.
1	Finger bruised	Jammed between two pieces of scrap.
1	Arm mangled, making amputation necessary	Caught between moving and stationary platform.
1	Sprained ankle	Jumped off roast pile.
1	End of thumb taken off.	Thumb caught between timber and bar.
1	Wrist injured	Fell from round house.

Table of Non-Fatal Accidents

Number.	Date of Accident.	Date of Recovery.	Name of Works.	Name of Owner.	Name of Injured.	Occupation of Injured.
1	Jan. 17	Jan. 30	Blast furnace.	Algoma Steel Corporation	O. H. Hugill	Repairman
2	" 16		do	do do	L. Maccaracca	Helper
3	" 31		do	do do	Jon Cwiakala	Keeper
4	Feb. 15		do	do do	G. Pricci	Laborer
5	" 15		do	do do	Robt. Hill	Millwright
6	" 4	Feb. 28	do	do do	Geo. Szuba	Helper
7	" 15	" 28	do	do do	Frank Daly	Laborer
8	Jan. 15	" 6	do	do do	Albert Snienek	do
9	Mar. 16		do	do do	G. Dulesandro	do
10	Jan. 11	Jan. 26	do	do do	S. W. Murphy	Blower
11	Mar. 19	Mar. 27	do	do do	Geo. Paulick	Keeper
12	April 4	April 17	do	do do	Jas. Dwyer	Electrician
13	" 26		do	do do	Isaac Waddle	Carpenter
14	" 26		do	do do	T. St. George	Pipe fitter
15	May 1		do	do do	P. Kovinich	Helper
16	" 2		do	do do	Toni Tersigno	Laborer
17	" 18		do	do do	M. Gutcher	Conductor
18	" 24		do	do do	F. Knorck	Helper
19	June 16		do	do do	P. Wilusz	Keeper
	" 16		do	do do	J. Kobratka	Helper
20	" 27	July 8	do	do do	Jos. Refcha	Laborer
21	July 6	" 15	do	do do	J. L. Radcliffe	Stove tender
22	" 23	Sept. 23	do	do do	Sam Pepovitch	Laborer
23	" 26	Aug. 18	do	do do	Geo. Uremovic	Helper
24	Aug. 14	" 27	do	do do	Thos. Edgar	Machinist
25	" 15	Sept. 16	do	do do	J. Mendetta	Laborer
26	" 15	Aug. 27	do	do do	Joe Jasensky	Keeper
27	" 17	" 30	do	do do	A. Marcellari	Laborer
28	" 19	" 27	do	do do	J. Zurowinski	do
29	" 20	Sept. 17	do	do do	S. W. Murphy	Blower
30	Sept. 3	" 15	do	do do	S. Walicky	Laborer
31	" 12	Oct. 1	do	do do	J. Wenovil	Helper
32	" 12	Sept. 27	do	do do	Geo. Szuba	do
33	" 16	" 30	do	do do	T. Saverio	Oiler
34	" 22	Oct. 14	do	do do	J. Wright	do
35	" 23	" 7	do	do do	Toni Pergomet	Laborer
36	Oct. 5	" 14	do	do do	Harry Knox	Water tender.
37	" 19	Oct. 28	do	do do	G. Aleghi	Oiler
38	" 29	Nov. 9	do	do do	E. Barberesi	Helper
39	Nov. 27	Dec. 9	do	do do	C. Desrochers	Laborer
40	" 28	" 6	do	do do	M. Sandoni	do
41	Dec. 3	" 15	do	do do	Peter Korale	Helper
42	" 17	" 30	do	do do	S. Gawant	do
43	" 2		do	do do	G. Volpe	Keeper
44	" 24		do	do do	G. Calabianchi	do
45	" 29		do	do do	Chas. Waters	Laborer
46	Mar. 14	May 30	Smelter	Canadian Copper Co.	Peronti Pielo	Brakeman
47	May 13	July 2	do	do do	Allan Bruce	do
48	July 8	" 17	Roast yard	do do	F. Krutisck	Laborer
49	" 19	Nov. 19	Smelter	do do	Gabriel Younie	do
50	" 19	" 19	do	do do	Ubaniti Veriato	Matte loader
51	" 25	Aug. 2	do	do do	John Katynka	Brakeman
52	" 26	" 22	do	do do	Jan Rogozynsky	Baleman
53	" 29	" 12	Roast yard	do do	John Switch	Foreman
54	" 30	" 12	Smelter	do do	Robt. Bell	Electrician
55	" 30	" 8	do	do do	P. Gardullo	Laborer
56	" 31	" 14	do	do do	M. Petroski	do
57	Aug. 4	Dec 19	do	do do	F. Pietro	do
58	July 23	Aug. 12	Roast yard	do do	A. Silvester	Water boy
59	" 23	" 20	Smelter	do do	W. Firborg	Laborer
60	" 28	Nov. 13	do	do do	W. Balmforth	Boilermaker's helper

at Metallurgical Works, 1912

Number Injured.	Nature of Injury.	Cause of Accident.
1	Fingers bruised	Fingers caught between cable and sheave.
1	Burns on back and neck.	While stopping iron notch, burned by iron.
1	Burn on ankle	Drilling cinder notch.
1	Face bruised	Struck by hammer.
1	Nose broken	Struck by falling bolt.
1	Head burnt	Burned while casting iron.
1	Gassed	Overcome by blast-furnace gas.
1	Left leg burned	Leg burned by hot iron.
1	Little finger broken	Caught between hoist box and pipe.
1	Leg and back burned	Burned by hot cinder.
1	Arms burned	While flushing furnace, cinder splashed.
1	Hand burned	Burned by fuse blowing.
1	Finger crushed	Piece of ore fell on finger.
1	Hand burned	Took hold of live wire.
1	Hand and arm burned	Iron splashed on him.
1	Foot scalded	Stepped in trough of boiling water.
1	Foot crushed and toe amputated	Slipped while making coupling.
1	Foot burned	Pulling bar from cinder notch and hot cinder splashed in his boot.
1	do do	While driving bar into iron hole, iron blew out.
1	do do	
1	Shoulders burned	Burned by hot coke from iron notch.
1	Foot cut	Cut foot on bar.
1	Leg broken	Fell off platform.
1	Burns on arms and chest.	Struck by hot iron while tapping.
1	Arm bruised	Caught by armature being lowered.
1	Cut and bruised	Caught between coke car and chute.
1	Leg bruised	Struck by hammer.
1	Eyes burned	Iron exploded while shovelling on coke braize.
1	Cut on head	Struck by falling bar.
1	Two fingers crushed	Fingers caught between sheave and cable.
1	Foot burned	Iron splashed while pulling bar from iron notch.
1	Finger cut	Ball of tuyere-puller caught finger.
1	Left foot burned	Hot cinder came out through gun.
1	Fingers crushed	Oiling sheave when cable came off.
1	Right arm cut	Fell down steps into basement.
1	Face burned	Gas blew out of stove.
1	Thumb cut	Cut by axe while chopping wood.
1	Left leg bruised	Fell into pit under engine.
1	Burn on right leg	Pot of cinder exploded.
1	Burns on hands	Burned while connecting two live wires.
1	Head cut	Struck by ore falling from bridge.
1	Foot burned	Drawing bar at cinder notch.
1	Arm burned	Hot cinder splashed while casting.
1	Eye injured	Gas blew cinder into eye.
1	Burn on foot	Iron splashed while drilling tapping hole.
1	Arm scalded	Steam escaped from steam pipe.
1	Right leg fractured	Fell between charging cars.
1	Injured internally	Squeezed between post and locomotive.
1	Thumb bruised	Thumb caught between two rails.
1	Arm and side injured	Fell into coke bin.
1	Arm broken	Arm crushed under sheet of matte.
1	Face burned	Oil on shovel caught fire.
1	Neck burned	Matte splashed, burning him on neck.
1	Rib broken	Foot slipped while mounting to cab of engine.
1	Finger cut	Finger cut by foot shears.
1	Arm and shoulder injured	While raising pole, it slipped and fell on him.
1	Finger bruised	Jammed between two pieces of scrap.
1	Arm mangled, making amputation necessary	Caught between moving and stationary platform.
1	Sprained ankle	Jumped off roast pile.
1	End of thumb taken off.	Thumb caught between timber and bar.
1	Wrist injured	Fell from round house.

Table of Non-Fatal Accidents

Number.	Date of Accident.	Date of Recovery.	Name of Works.	Name of Owner.	Name of Injured.	Occupation of Injured.
61	Aug. 3	Aug. 14	Smelter	Canadian Copper Co.	Wm. Hickey	Conductor
62	" 5	" 19	do	do do	Richard Death	Fitter
63	" 7	Sept. 2	do	do do	S. Luigi	Laborer
64	" 10	" 3	do	do do	J. Cadovius	Electrician
65	" 24	" 2	do	do do	D. Gregolinsky	Baleman
66	Sept. 1	" 11	do	do do	Fratini Antonio	Tapper
67	" 7	" 19	do	do do	John Ropkuski	Lineman
68	" 9	" 18	do	do do	Andri Katrinike	Baleman
69	" 15	" 27	do	do do	Twan Halusyzk	Laborer
70	" 18	Oct. 15	do	do do	John Korneski	do
71	" 22	" 2	do	do do	W. Brezwzlez	Tapper's helper
72	" 8	Sept. 21	do	do do	G. Federico	Laborer
73	" 24	Oct. 14	do	do do	Wm. Uttley	Fitter
74	" 25	" 3	do	do do	H. Knowles	Tapper's helper
75	" 23	" 3	do	do do	E. Biggs	Pattern-maker
76	Oct. 6	Nov. 1	do	do do	Victor Niemi	Rigger
77	" 4	Oct. 15	do	do do	O. Gentile	Fitter
78	" 5	" 15	do	do do	G. Attillio	Laborer
79	" 12	Dec. 10	do	do do	Ernest Bray	Fitter
80	" 14	Oct. 30	do	do do	G. Luigi	Laborer
81	Nov. 4	Dec. 16	do	do do	Toni Denioff	do
	" 4	" 16	do	do do	John Dutchoff	do
82	" 6	" 19	do	do do	J. Zandri	Carpenter
83	Oct. 24	Nov. 15	do	do do	Yacko Syrajko	Laborer
84	Nov. 20	Dec. 11	do	do do	Fred Ferrar	Carpenter
85	Oct. 25	Nov. 11	do	do do	Varzi Jasgon	Baleman
86	Nov. 1	" 26	do	do do	P. Boridez	Tapper
87	" 19	" 28	do	do do	Yan Baby	Laborer
88	" 21	Dec. 27	do	do do	B. Foleo	do
89	" 18	" 9	do	do do	P. Crevaglin	Fitter
90	" 25	" 16	do	do do	Jas. Bruce	Brakeman
91	" 28	" 11	do	do do	G. Barduzzi	Baleman
92	Dec. 4	" 12	do	do do	L. Clemante	Tapper
93	Nov. 26	" 12	do	do do	Geo. Treverthen	Fitter
94	" 9	Nov. 25	do	do do	B. J. Vaillancourt	Conductor
95	Oct. 26	" 14	do	do do	A. Walmsley	Engineer
96	Dec. 10	Dec. 23	Roast yard	do do	Jak Huxta	Laborer
97	" 12	" 27	Smelter	do do	Pit Balon	do
98	" 12	Jan. 7	do	do do	B. Yasyan	do
99	" 18	Dec. 30	do	do do	W. Hanlon	Straw boss
100	" 20	Jan. 3	do	do do	S. Auguste	Laborer
101	" 24	" 5	do	do do	Wm. Knoellinger	Tapper's helper
	" 24	Dec. 31	do	do do	Geo. Vestoin	Tapper
102	" 24	" 31	do	do do	Joe Guiseppe	Laborer
103	" 25	Jan. 1	do	do do	D. Baseowski	Brakeman
104	" 29	" 15	do	do do	M. Larini	Oiler
105	Nov. 18	Dec. 10	Roast yard	do do	Andrew Bryson	Engineer
106	July 19	Oct. 19	do	do do	Pleon Kysko	Laborer
107	April 2	May 1	Silver refinery	Coniagas Reduction Co.	G. Poratto	Tapper
108	July 11	Aug. 30	do do	do do	D. Lazan	Laborer
109	" 30	" 29	do do	do do	E. Maynard	do
110	Nov. 5	....	do do	do do	D. Marcanato	do
111	" 9	Nov. 25	do do	do do	E. Matterollo	do
112	Dec. 14	Jan. 9	do do	do do	H. Bradley	Master mechanic
113	Sept. 16	Perm'nt	Roast yard	Mond Nickel Co.	L. Pizzolotto	Laborer
114	Dec. 26	....	Smelter	do do	S. Hutchiel	Brakeman
115	May 27	July 3	Blast furnace	Steel Company of Canada	F. Defenso	Boilerman
116	June 18	Aug. 7	do do	do do	S. Randisen	Laborer
117	July 1	July 14	do do	do do	S. Di Matteo	Helper
118	" 9	Aug. 9	do do	do do	J. Parrini	Laborer
119	Aug. 25	Sept. 4	do do	do do	F. Dicchio	Cage tender
						Total.....

at Metallurgical Works, 1912.—Continued

Number Injured.	Nature of Injury.	Cause of Accident.
1	Head cut	Fell into ore bin.
1	Ankle hurt	Struck on ankle by steel plate.
1	Finger crushed	Finger crushed by piece of slag.
1	Ankle sprained	Fell from ladder.
1	Knee jammed	Jammed while coupling cars.
1	Foot burned	Matte splashed on foot.
1	Face and arms burned	Short circuit on 2,200-volt wires.
1	Thumb jammed	Caught between ladle and bale.
1	Head and back injured	Tile fell from roof on him.
1	Body and arm scalded	Scalded by exhaust from hoist.
1	Arm and side burned	Burned by matte flowing from tap-hole.
1	Foot injured	Wheelbarrow upset.
1	Ankle injured	Slipped off platform.
1	Leg injured	Wheelbarrow fell on him.
1	Thumb cut	Cut by chisel.
1	Face burned	Lighting fire with coal oil.
1	Hand cut	Hand cut while working on drilling machine.
1	Fingers jammed	Hand caught in gear wheels of planer.
1	Foot injured	Section of slag-pot fell on foot.
1	Fingers jammed	Fingers jammed between lever and car.
1	Left leg fractured	Elevator for hoisting brick fell with men on it.
1	Left arm fractured	do do do do
1	Fingers cut	Cut by saw.
1	Foot burned	Hot slag splashed on him.
1	Hand cut	While sharpening knife, hand slipped.
1	Fingers crushed	Caught between bale and post.
1	Foot burned	Sample can exploded.
1	Shoulder and leg bruised.	Squeezed between engine and column.
1	Finger injured	While emptying slag-pot, caught between cogs.
1	Eye injured	Struck by spark from emery wheel.
1	Foot bruised	Fell from footboard of locomotive.
1	Foot burned	Matte splashed while casting.
1	Head and face bruised	Fell into pit in reverberatory building.
1	Finger crushed	Crushed under piece of iron.
1	Rib fractured	While coupling, was thrown against tender.
1	Ribs fractured	Fell from engine.
1	Foot bruised	Piece of rail fell on foot.
1	do	Wheel of truck passed over foot.
1	Left side bruised	Struck by shell of slag-pot.
1	Arm broken	Car jumped track, crushing arm against post.
1	Leg bruised	Struck by shell of slag-pot.
1	Face and head burned	Explosion of matte.
1	do do	do do
1	Toes bruised	Dropped piece of matte on toe.
1	Leg bruised	Caught by car while coupling.
1	Hand and face burned	Gas blew out of crucible furnace.
1	Finger crushed	Hand caught between cross-head and guide bar.
1	Leg bruised	Stick of wood rolled on leg.
1	Left foot burned	While tapping furnace, speiss splashed on foot.
1	Foot burned and bruised.	Cap of tuyere fell on foot.
1	Three ribs broken	Struck by train.
1	Shock	Bag of soda ash rolled on him.
1	Back bruised	Caught by revolving shaft.
1	Foot crushed	While unloading generator, it fell on him.
1	Back broken	Caught in moving line of aerial tram, and thrown to ground, a distance of 15 feet.
1	Arm amputated	Fell between locomotive and car.
1	Right foot burned	Stepped into hot flue dust.
1	Left leg crushed	Pile of pig iron fell on him.
1	Hand burned	Pig iron cut through cinder gate.
1	Toes crushed	Pig iron he was carrying fell on his foot.
1	Toes injured	Buggy came down on toes.
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MINES OF ONTARIO

By E. T. Corkill, Chief Inspector of Mines

I.—NORTHWESTERN ONTARIO

About the same number of properties were being worked in northwestern Ontario in 1912, as in the preceding year, but the production was a little larger. The expected revival of gold mining in the Lake of the Woods area and at Sturgeon lake did not take place, although considerable gold was produced at the St. Anthony mine in the latter area.

The mining of iron pyrites at the Northern Pyrites mine on Big Vermilion lake, is one of the important industries in this part of the Province. Little ore has as yet been shipped, but the mine is being systematically developed and the ore body blocked out.

The blast furnace of the Atikokan Iron Company was not operated during the year, but development work at the mine owned by this company was carried on.

The quarry industry is becoming important in this part of Ontario. Trap rock found within the limits of Port Arthur has proved a boon both to that city and to Fort William, in providing a readily accessible supply of practically the best kind of rock for building roads. This has been used in the construction of some splendid roads, and also for concrete work. Rock for the latter purpose was also obtained along the lake shore from the talus slopes of the hill. The Canadian Pacific railway have, it is understood, let a contract for the supplying of two million yards of crushed stone to be used in ballasting the railway between Fort William and Winnipeg. If the railways adopt this system of ballasting their tracks, which must tend to permanency, a further stimulus will be given to the quarry industry, not only in this part but throughout the whole Province.

Lake of the Woods Area

But little actual mining was carried on in this area during 1912. A small quantity of ore was taken out at the Cameron Island gold mine, and a mill run made for the purpose of testing the ore. A couple of men were also working on the Olympia, and some ore put through the mill. During the first part of the year, a little work was done underground on the Ophir.

At the Scramble mine, situated on lots 13 and 14 of the sixth concession of Jaffray, a few miles north of Kenora, the Canadian Homestake Company, under the management of Charles Brent, have been installing machinery and making preparations for active development of the property. A transmission line has been built from Kenora to the mine, and the mine machinery is to be driven by electricity. The town of Kenora sell electric power at the low rate of ten dollars per horse-power per year.

Upper Manitou Lake Area

A few men were employed underground at the Laurentian mine by the Great Golconda Mines, Limited, for part of the year, and the ore taken out was run through the mill. Practically no new underground work was done, as the men were engaged chiefly in clearing up the old workings and taking out ore that had been left broken. Mr. Dryden Smith was in charge of operations. The Big Master mine was pumped out and an examination made, but no mining work was done.

Sturgeon Lake Area

Assessment work was done on a number of claims in this area, but little actual mining was attempted at any of the properties except the St. Anthony.

St. Anthony Gold Mine

Work was carried on continuously at the St. Anthony mine, by the Sturgeon Lake Development Company, throughout the year, employing a force of 120 men.

The main shaft is 175 feet in depth, the first level being at 100 feet. On the first level a drift has been run north 100 feet and a stope opened up for 160 feet along the vein and ore stoped out for a height of 60 feet. A cross-cut has been driven from the shaft east a distance of 275 feet, and a drift run on the main vein south 540 feet. From this point a cross-cut has been driven southeast 340 feet and a vein cut at a point 200 feet from the main vein, on which 100 feet of drifting has been done. A raise has been put up on this vein 40 feet. On the second level drifts have been run north from the shaft 120 feet and south 540 feet. At a point 210 feet south of the main shaft a winze has been sunk 100 feet, and 100 feet of drifting done north and south of the winze. Auxiliary exits have been provided from the first level to the surface north and south of the shaft, and from the second level to the first at a point 400 feet south of the shaft. Stoping has been done on the first level for 350 feet along the vein south of the shaft, and for 160 feet on the second level.

The mill has been remodelled, and a cyanide plant was being put in the latter part of the year. The ore is hoisted from the mine in cars on a cage and trammed to the mill, a distance of 250 feet, where it is dumped into a jaw crusher. The crushed product is elevated to storage bins, from which it is fed to two five-stamp batteries. The product from the stamps passes directly to a ball mill which crushes to about 100-mesh. The pulp from the ball mill then passes over amalgamating plates and then over slime tables. The product from these tables is then cyanided, using a Hardinge pebble mill as an agitator.

The power plant consists of three 125 horse-power Mumford boilers, two 125 horse-power return tubular boilers, an eight-drill Alley and McLennan (Glasgow) compressor and hoist.

The officers ot the company at the time of inspection were Mr. George Glendinning, president, and Mr. G. F. McNaughton, mine manager.

Other Areas

Elizabeth Gold Mine

The Elizabeth gold mine, situated at the north end of Rice lake, two miles north of a point on the Canadian Northern railway, five miles west of Atikokan, is owned and operated by the Elizabeth Gold Mines, Limited, of which Mr. R. R. Gamey is president.

The main shaft is 240 feet deep, and there are levels at 65, 128 and 220 feet. On the first level the north drift is in 75 feet. The former operators carried a stope above this drift to a height of 35 feet. The present owners are underhand-stoping from the floor of the level to a raise from the second level. On the second level a drift has been run north 175 feet, and some cross-cutting done. No work was being done on the third level.

The power plant consists of one 40 and one 60 horse-power return tubular boiler, one 40 horse-power locomotive type of boiler, and the high pressure half of a 4- and a 6-drill compressor. The mill is located about 300 feet from the shaft on the hillside. In the mill is a gyratory crusher, a 10-stamp battery, an engine for driving the above, and amalgamating plates. The mill was in operation for part of the year.

Northern Pyrites Mine

This mine was operated during the year by the Northern Pyrites Company of 25 Broad Street, New York. Mr. Robert K. Painter is consulting engineer, and Mr. H. V. Smythe, superintendent, employing a force of eighty-five men.

No ore was shipped during the year, the old aerial tram being out of commission. A new Leischan aerial tram, two miles in length, was constructed during the latter part of the year from the mine to the Grand Trunk Pacific railway at a point about nine miles west of Graham.

The Nos. 1 and 2 shafts have not been sunk any deeper than described in the last Report of the Bureau of Mines. The main work done during the year was to block out ore on the second and third levels, and to stope, leaving the broken ore in the stopes. A raise was put through to the surface from the second level from a point about 300 feet east of No. 2 shaft.

The power plant at No. 1 shaft consists of three 100 horse-power return tubular boilers, a 12-drill Rand cross compound compressor and an electric light plant. The ore is crushed at No. 2 rock house, by a No. 3 and a No. 5 Austin gyrator crusher, and then elevated to bins over the aerial tram terminal. Hoisting from No. 2 shaft is done by a 30 horse-power Flory double-drum hoist in two skips of one-ton capacity dumping directly into the crusher.

Spar Island, British North American Mining Company.

Spar Island Silver Mine

The only mine being worked for silver in this area is situated at Spar Island, 20 miles southwest of Port Arthur. This is owned and operated by the British North American Mining Company, Canada Life Building, Montreal; President, Mr. W. Goff Penny, and Superintendent, Mr. R. A. Lockerby.

The shaft is sunk on a vein of calcite, which cuts across the west end of the island and can be seen extending under the water of the lake. The shaft is 150 feet deep with 75 feet of drifting on the 75-foot level.

The power plant consists of one 60- and one 40-h.p. marine type of boiler, and a 3-drill straight line compressor.

Atikokan Iron Mine

The principal work done during the year at this mine was to drive four new working tunnels through the hill in which the ore body occurs at intervals of about 500 feet. These tunnels average 300 feet in length. Two shafts have been sunk 150 feet deep, and 150 feet of cross-cuts driven. A third shaft is being sunk 700 feet west of the old tunnels.

Mr. J. Dix Fraser is manager for the operators, the Atikokan Iron Company, and Mr. F. Rodda, superintendent.

The blast furnace of the company at Port Arthur was not in operation during the year.

Quarries

In the northwest part of the city of Port Arthur the Intercities Quarries Company, Limited (formerly known as Messrs. Stewart and Hewitson), are operating a trap rock quarry. The trap has a thickness of about 20 feet resting on the Animikie slates, and only the trap is excavated. The floor of slate has a dip to the south of about 20 degrees. The main excavation is about 300 feet by 175 feet, with walls 20 feet in height. Other excavations have been opened up along the ridge, but the main production comes from the above, where the crushing plant is located. The rock is hoisted in cars of a capacity of about two cubic yards, and dumped into a large gyratory crusher which reduces it to about a 4-inch product. This is elevated by a belt conveyer to bins, from which it passes into two gyratory crushers, crushing it to a 2-inch product, which is elevated to storage bins over a standard gauge railway, connecting with the Fort William and Port Arthur Electric Railway lines.

The crushed rock is used mainly for road building, for which purpose it is unexcelled, and for concrete work. Practically all the macadamized roads around Port Arthur and Fort William are made of this rock, and their excellence and good wearing properties show clearly its superiority as a road metal.

Messrs. Bannerman and Horne opened up a quarry of granite during the year near Ignace.

The Great Lakes Dredging Company had a clam-shell at work along the shore west of Fort William, taking out rock from the talus slopes of the hills along the shore for use in the concrete work of the breakwater at Port Arthur and other works.

II.—SUDBURY and the NORTH SHORE

The year 1912 was one of the most prosperous in the history of nickel mining in the Sudbury area. A great amount of diamond drilling was done, which located some very large ore bodies. On an average, from 18 to 20 diamond drills were in operation during the year, prospecting for nickel in the Sudbury area, and about 80,000 feet of drilling was done.

Both the Canadian Copper Company and the Mond Nickel Company are widening their field of operations by developing new properties and enlarging their smelting plants. The latter company's new smelting plant at Coniston was nearly completed. The Dominion Nickel Copper Company sold out their entire holdings the first part of 1913. The new owners have commenced active mining work on the old Murray property, and purpose building a smelter near that mine.

The Moose Mountain iron mine was idle part of the year, but the new concentrator was practically completed and the old concentrating plant renovated. The company expect to operate the mine continuously throughout the year.

Owing to lack of power the Canadian Exploration Company at Long Lake did not operate extensively during the year. With the completion of the second power plant of the Wahnapitae Power Company, power was obtained in the latter part of 1912 and the mill put in operation. The company expect to operate their mill to capacity during 1913.

In the West Shining Tree area there was very little actual mining done during the year. Some of the owners of claims sank on their veins to a depth of 25 to 50 feet, but most of the work done was assessment work, mainly stripping.

In the Michipicoten area there was little done outside of iron mining by the Algoma Steel Corporation at the Helen and Magpie mines. Here work was carried on throughout the year with about the same force of men as in 1911. Development work was carried ahead at the Magpie mine, and the first unit of the roasting plant completed and put in operation in December. The Grace gold mine was unwatered, and it was the intention of the management to sink the shaft 100 feet.

Accidents

During 1912 there were 11 men killed in and around the mines in this area, 5 men at the blast furnace at Sault Ste. Marie, and 3 men at the smelters, or a total of 19 men. This shows a decrease of 2 compared with the previous year, although there was a considerable increase in the number of men employed.

Canadian Copper Company

As in 1911, all the production of the Canadian Copper Company for 1912 came from the Creighton, Crean Hill, and No. 2 mines, the greater part coming from the Creighton. Development work was carried on at No. 3 mine, where diamond-drilling has shown up an ore body, according to company reports, of over twenty-five million tons of ore. The company have built a railway from Copper Cliff to No. 3 mine, and are installing a large power plant. The new reverberatory furnaces at the smelting plant, Copper Cliff, were completed and operated during the year.

Mr. A. P. Turner has resigned from the Presidency of the company and has been succeeded by Mr. John Lawson, who for a number of years has held the position of general superintendent. Mr. D. H. Browne is metallurgist, and Mr. W. W. Mein was during the year appointed consulting mining engineer.

Creighton

The larger part of the production of the Canadian Copper Company during 1912 came from the Creighton mine.

The main No. 2 shaft remains the same depth, though No. 1 shaft was continued to the fifth level, a depth of 350 feet, and connected by drift with the No. 2 shaft. The principal development work of the year was done on this level where the ore body between Nos. 1 and 2 shafts was blocked out for a length of 300 feet by a width of 200 feet. The method of mining the ore in this level is the same as formerly described for the fourth level. A drift has been run from the No. 2 shaft southwest 300 feet to the west ore body, which has been blocked out for a length of 150 feet by a width of 100 feet. An ore pocket has been cut out at the station of this level. A winze has been sunk a depth of 100 feet at a point 150 feet from the shaft, and the work of sinking the shaft to the sixth level commenced the latter part of the year. The broken ore in the stopes of the fourth level has been drawn out during the year, and part of the floor between the third and fourth levels broken down. Stoping was also carried on during the year in the north end of the open cuts from the surface to the third level.

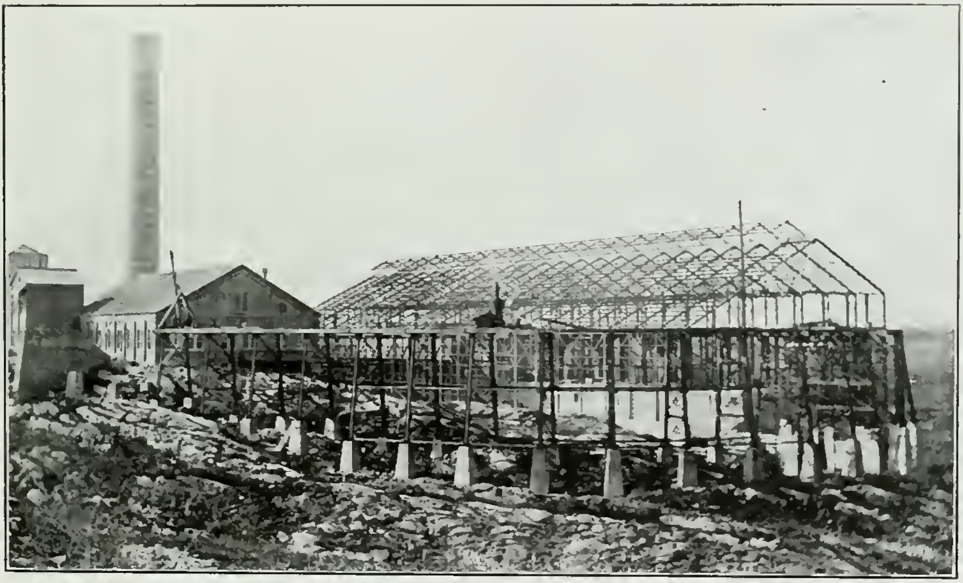
The surface plant has been enlarged by the installation of a 20-drill compressor. The old dry was renovated by taking out the old lockers and introducing a system of hooks suspended from the ceiling by ropes running through pulleys.

Crean Hill

Work was carried on at this mine during the year on the fifth, sixth and seventh levels. The ore is mined by the filling system, the stopes being filled with rock sorted from the ore. Sorting is carried on both in the stopes and in the rock-house. The ore body on the seventh level has been opened up for a length of 120 feet by about the same width. A sub-level has been opened up between the sixth and seventh levels, and the ore broken is trammed through a chute from the seventh level.

No. 2 Mine

The main shaft at this mine was sunk from the eighth to the ninth level during the year, a vertical depth of 700 feet, being the deepest workings now operated by the company. The ore body on the ninth level is reached by a drift 240 feet in length. Work was carried on during the year on the seventh, eighth and ninth levels, and the same system of ore extraction followed, as outlined in former reports.



Power house, skeleton steel of charge trestle and smelter building, Mond Nickel Co., Coniston.

No 3 Mine

Active development work on the No. 3, or Frood mine, was carried on throughout the year. The No. 1, 4-compartment shaft, sunk on an incline of 77 degrees, was carried to the fourth level, a depth of 400 feet. The stations were cut on the second, third and fourth levels, and drifting begun. The No. 2 vertical 3-compartment shaft, located 625 feet northeast of No. 1 shaft, has been sunk a depth of 200 feet.

In addition to mining, a large amount of construction work was done, consisting of building a steel head-frame at No. 1 shaft, a brick power house and a large number of houses for the employees. The power line from Copper Cliff to the mine was completed, as was also the railway. A 3-drum electric hoist and a 20-drill compressor were installed.

Dill Quartz Quarry

About 300 tons of quartz per day were mined and shipped from the quarry in Dill township. The quartz is mined by open cut work, which is now about 350 feet long, 100 feet wide and 50 feet deep. The quartz is loaded into railway cars by derricks, and hauled to Copper Cliff, where it is crushed for use at the furnaces and converters.

Smelting Works

A complete description of the additions to the smelting plant was given in the last Report of the Bureau of Mines. Further improvements were carried on during the year in the reverberatory plant, and a new furnace was erected which increases the smelting capacity about twenty per cent. The company have now under consideration plans for doubling the capacity of the plant.

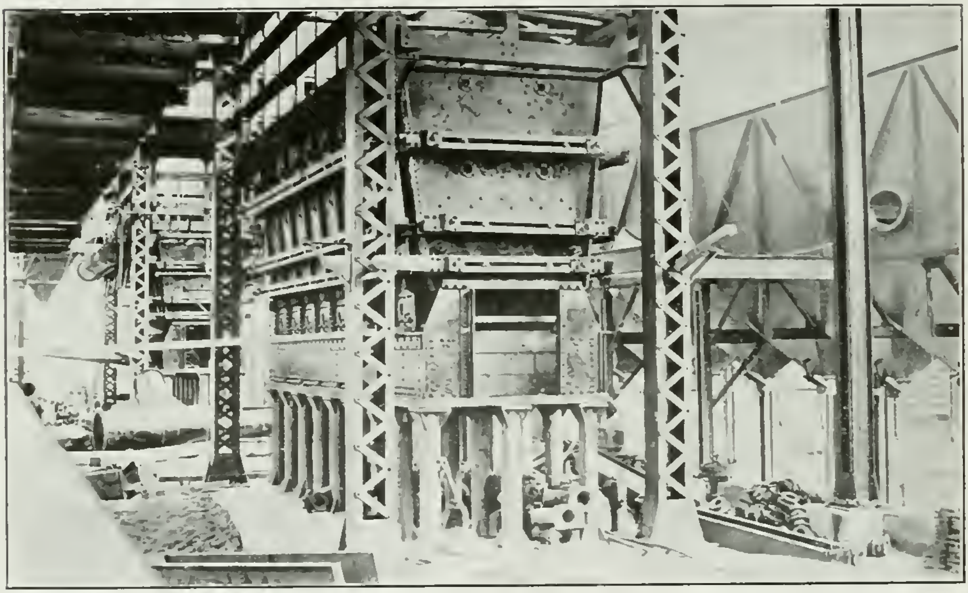
Cobalt Silver Refining Plant

The company decided during the year to discontinue the operation of this plant, and consequently the whole plant was only in operation part of the year.

Mond Nickel Company

All the production of the Mond Nickel Company during the year came from the Victoria and Garson mines.

Development work was carried on at the Frood Extension mine, and the North Star mine, about three miles from the Creighton, was reopened. The company's new smelter at Coniston was completed in June, 1913.



Furnaces during erection, Mond Nickel Company, Coniston.

The officers of the company are: Mr. C. V. Corless, manager; Mr. O. Hall, mines superintendent, and Mr. J. E. Robertson, smelter superintendent.

Victoria Mine

The main shaft at this mine is now at a depth of 1,850 feet vertically; by far the deepest shaft in the Province. The main operations during the year were confined to stoping on the eighth, ninth, tenth, eleventh and twelfth levels, carrying on exploratory work on the fifth, and locating and blocking out the ore body on the thirteenth level. The shaft is now being sunk to the 2,000-foot level.

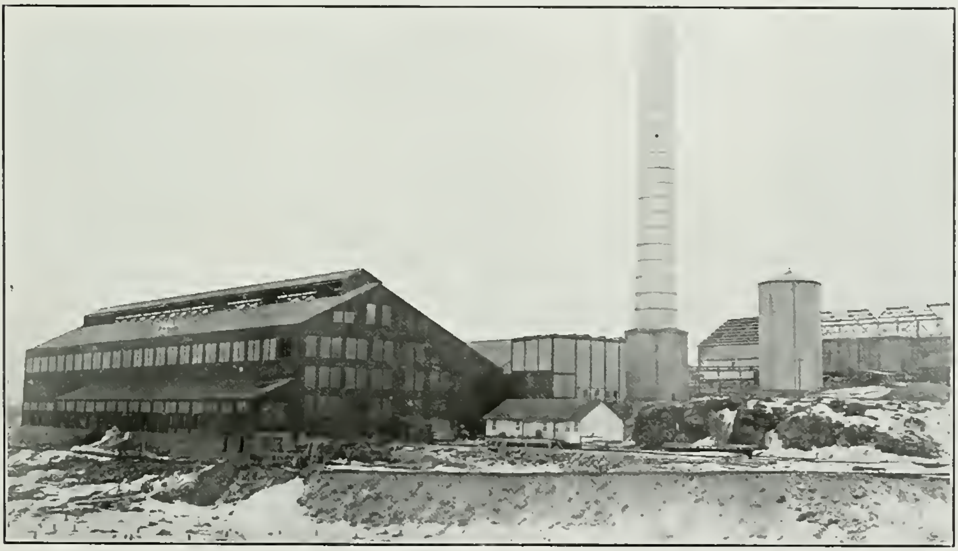
Garson Mine

The ore produced from this mine during the year came from the first, second, third, fourth and sixth levels. The shaft was sunk 100 feet during the year, making it 700 feet in depth. On account of the ore bodies dipping to the east and being irregular in outline, the plans of the workings of the several levels projected to the surface cover a large area and are difficult to describe. Some of the stopes are mined by filling, and others are worked by underhand stoping. The head frame has been raised to permit the use of automatic dumping skips having a capacity of four to five tons. A new double drum electric hoist was installed during the year. This hoist is equipped with an automatic device to prevent overwinding, and also with a device to govern the speed of hoisting or lowering.

Mr. A. Sharp is mine superintendent, employing 400 men.

Frood Extension Mine

The shaft at the Frood Extension was sunk during the year to a depth of 600 feet. A station was cut at a depth of 400 feet, and a cage put in the central hoisting compartment to hoist and lower the men to this level. The work of sinking the shaft is being continued, it being the intention of the management to sink to a depth of 1,000 feet.



General view of smelter building, Mond Nickel Company, Coniston.

A transmission line from Victoria mines was erected, a power house built, and preparations made for the installation of a large compressor and hoist.

Mr. J. H. Stovall is superintendent.

Dominion Nickel Copper Company

This company operated during the year on the Whistle property on the north nickel range. All the work was done on the adit level or above it. This main adit is 440 feet in length, and drifting and cross-cutting have been done from it to explore the ore bodies. Three raises were put through to the surface.

The company had several diamond drills at work on the Murray mine property the last half of the year, and were successful in blocking out a large tonnage of ore.

The Dominion Nickel Copper Company disposed of their holdings early in 1913, and the new owners are operating tentatively under the name of Holmes and Wilson. It is proposed to open up the Murray mine and a new shaft has been started. The company also purposes building a smelter near the Murray mine.

Gold

Long Lake

The Canadian Exploration Company did not operate their mill on their Long Lake gold property during the year, owing to lack of power. They enlarged it, however, by the addition of 10 stamps, and made some changes in the cyanide department. The company secured power from the Wahnapitae Power Company early in 1913, and commenced work. During 1912 further development work was carried on underground.

Iron

Moose Mountain

There was but little mining work done at the Moose Mountain mine until the latter part of 1912. Most of the ore is taken from the No. 1 deposit by open-cut work. The open cut is about 200 feet long by 150 feet wide. A 3-compartment shaft has been sunk to a depth of 100 feet, a large station cut, and 200 feet of drifting done. Some work was also done at the No. 2 deposit about half a mile north of No. 1.

The new mill is located near No. 2 deposit, and was nearly completed during the year. The old mill near No. 1 deposit is still used for the concentration of the ore from this deposit.

Mr. F. A. Jordan is manager, employing a force of 150 men.

Algoma Steel Corporation

The Algoma Steel Corporation operated the Helen and Magpie mines in the Michipicoten area and the blast furnace at the Sault during the year. Mr. T. J. Drummond is president of the company; Mr. J. Frater Taylor, vice-president, and Mr. R. W. Seelye, manager of the mines department.

Helen Iron Mine

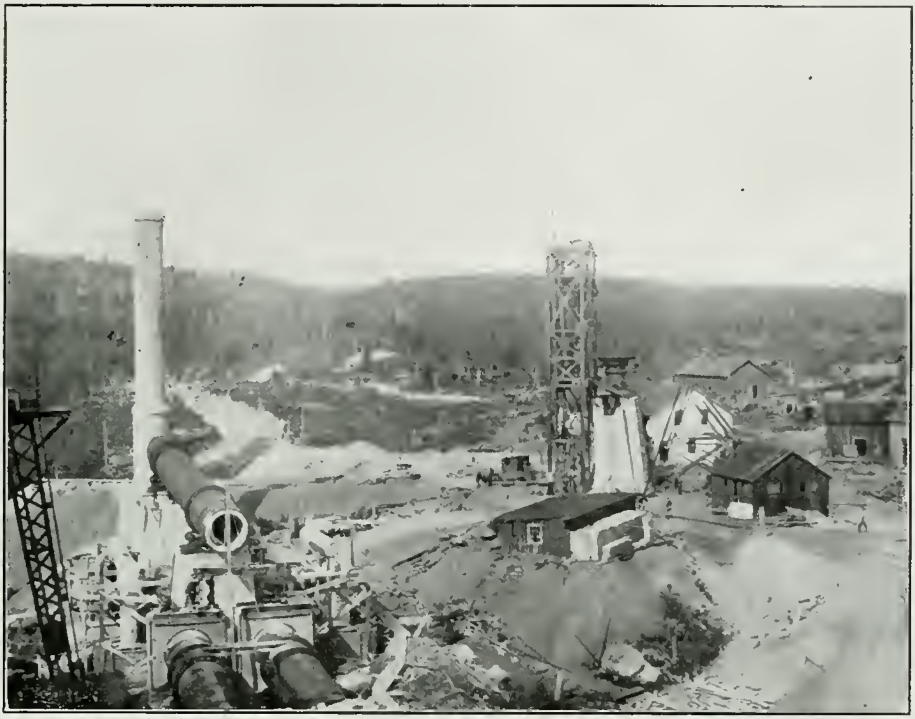
The production of hematite from the Helen mine in 1912 was not as great as in 1911. This was due mainly to the nature of the ore encountered on the lower levels of the mine which necessitates a different system of mining; also to the fact that the area of marketable ore on the levels is getting smaller. The main No. 2 shaft is down to the ninth level, a vertical depth of 650 feet from the surface. Owing to the upper part of this shaft being in loose material, it was decided to put up an incline as a continuation of the No. 2 shaft from the fourth level in the solid rock. This incline shaft from the surface to the fourth level is about 475 feet in depth.

The company secured their shipping ore during the summer from the sixth, seventh and eighth levels, where it is mined by the caving method, driving sub-levels every 20 feet and slicing. The ore body on the levels has been opened up similarly to the upper levels described in former reports. All the ore shipped is washed to lessen the sulphur content.

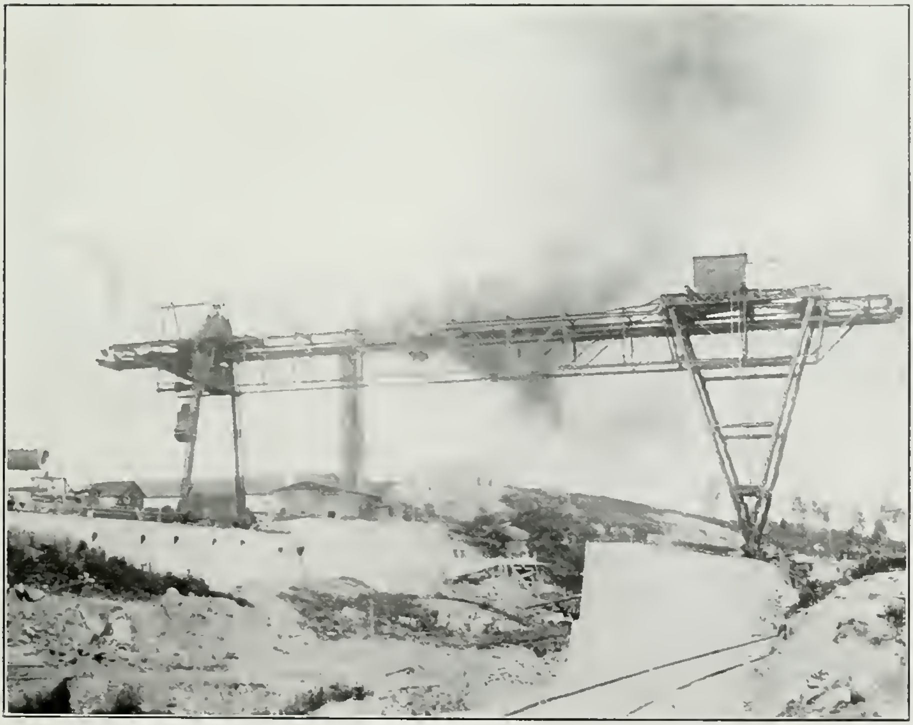
Mr. R. W. Seelye is manager, and Mr. A. A. Mackay, mine superintendent, employing 250 men.

Magpie Mine

The main shaft has been sunk to a depth of 225 feet, with levels at 125 and 205 feet. On the first level drifts have been run east 650 feet and west 1,050 feet on the south side of the vein. Cross-cuts have been run at intervals of about 30 feet across the ore body. Three sub-levels have been driven east and west of the shaft above the first level along the middle of the vein at intervals of about 25 feet, and raises put up for drawing off the broken ore. On the second level drifts have been run east 550 feet



Magpie mine, showing shaft house and roasting plant in course of construction.



Magpie mine—Ore bridge.

and west 700 feet. A number of cross-cuts have been run across the ore body, and a raise put through to the first level. A new steel head frame 75 feet in height was erected, and a crushing plant put in consisting of one No. 8 and two No. 5 Austin gyratory crushers. A belt conveyor carries the broken ore from the ore bins to the calciners.

The roasting plant consists of one calcining tube 120 feet long and eight feet in diameter, two roasting tubes each 60 feet long, two 10-foot Chapman rotary gas producers, a coal-crushing plant and belt conveyors. A concrete stack for the calcining plant 105 feet high has been built. An ore bridge of 148 feet span with concrete walls for track has been erected for loading the ore from the roasting plant into cars, and for handling the coal for the roasting plant.

The power plant consists of five 100-h.p. Waterous boilers, a 16-drill compressor belt-driven by a 280-h.p. motor. a double drum hoist for handling the 2-ton Kimberley skips, and a single drum hoist for the cage. Electric power is to be obtained from Steep Hill falls on the Magpie river. Mr. J. Bartlett is superintendent.

Blast Furnace, Sault Ste. Marie

The Algoma Steel Corporation had three furnaces in blast during 1912, producing about 800 tons of pig iron per day. The total production of ore from the Helen mine was used at the furnaces along with American ore.

III.—TEMISKAMING

Cobalt and Vicinity

The production of silver from the mines of Cobalt and vicinity in 1912 was not quite so great as in the preceding year, the total yield being 30,243,859 ounces, compared with 31,507,791 ounces in 1911. The value, however, was greater, owing to increased prices for silver. The production came largely from the same mines as in 1911, though some of the properties increased their output. Owing to the higher price of silver, work was resumed on a number of properties that had formerly been worked; as a result, more men were employed in the camp. A number of the Cobalt mines have been working a 10-hour day, and others a 9-hour day, paying approximately the same wages. In February, 1913, all the mines in the camp adopted a 9-hour day from surface to surface for the underground men. The wages have been left the same for the 9-hour day as they were formerly.

Power

The power situation for the year was quite satisfactory in the Cobalt camp. Electric and air power was furnished to all the mines by the Northern Canada Power Company.

Concentration

The following table gives a list of the concentrating mills and the normal capacity of same in the Cobalt camp. Practically all these mills were operated to their full capacity during the year:—

Mill	Capacity per day	No. of Stamps	Remarks
	tons		
1 Beaver	90	Crushing by rolls	Increasing capacity in 1913
2 Buffalo	145	" "	
3 Cobalt Central	75	" "	
4 Cobalt Lake	75	20	Doubling capacity in 1913
5 Colonial	25	10	
6 Coniagas	180	60	
7 Dominion Reduction	120	40	Customs mill
8 Hudson Bay	60	20	
9 King Edward	30	10	
10 McKinley-Darragh-Savage	165	30	Adding 20 stamps
11 Nipissing	200	40	
12 Nipissing Reduction	50	Crushing by rolls	Customs mill.
13 Northern Customs	350	120	" "
14 O'Brien	100	30	
15 Silver Cliff	75	Crushing by rolls	
16 Temiskaming	125	40	
17 Trethewey	100	30	
Outlying Camps			
18 Casey-Cobalt	30	10	Doubling capacity in 1913
19 Wettlaufer	30	Crushing by rolls	
20 Miller Lake-O'Brien (Millerett)	30	10	Recently purchased from Millerett Mine
Total	2,055	470	

The Buffalo, Dominion Reduction, Nipissing and O'Brien use cyanidation in conjunction with concentration. The Nipissing high-grade mill was in operation during 1912, treating practically all the high-grade ore from that mine. The Buffalo mines were engaged during the latter part of the year in building a mill for treating their high-grade ore. The mill was completed and put in operation early in 1913.

Smelting

The Ontario smelters handled about 60 per cent. of the total number of ounces shipped during 1912. These smelters were as follows:—

1. Canada Refining and Smelting Company, Orillia.
2. Canadian Copper Company, Copper Cliff.
3. Coniagas Reduction Company, Thorold.
4. Deloro Mining and Reduction Company, Deloro.

The works of the Canada Refining and Smelting Company were destroyed by fire late in the year, and have not yet been rebuilt.

The Canadian Copper Company closed down their silver smelter during the latter part of the year and it is not intended to resume operations.

The foreign companies buying silver-cobalt ores were:—

1. American Smelting and Refining Company, New York.
2. Balbach Smelting and Refining Company, Newark, N. J.
3. Pennsylvania Smelting Company, Pittsburg, Pa.
4. United States Metals Refining Company, New York.
5. Beer, Sondheimer & Company, Frankfort-on-Main, Germany.
6. Government of Saxony, Saxony, Germany.

Accidents

During 1912 in the Cobalt camp proper, there were seven fatal accidents, causing the death of seven men, a decrease of two compared with the preceding year. As there were approximately 3,500 men employed in the Cobalt camp during the year, this would give an accident rate of two men killed per 1,000 men employed.

Two men were killed in one accident in the outlying silver areas during the year, compared with three in the preceding year.

Mr. T. F. Sutherland is the resident Inspector at Cobalt. He also inspects the mines in the outlying silver districts and in the Porcupine camp. It is the aim of the inspection department to inspect the mines at least once every three months. This was not found possible during 1912, but the majority of the mines were visited two or three times, and those requiring it more frequently.

Outlying Silver Camps

The Casey Cobalt mine in Casey township, about nine miles east of New Liskeard, was one of the most important shippers among the outlying silver mines during the year. The property has been worked for a number of years, but only during the last year has it ranked as an important producer.

In South Lorrain, the principal shipper continues to be the Wettlaufer, though considerable work is being done on some of the surrounding properties. The Keeley mine was not worked during the year, but it was taken over by another company early in 1913 and is again being operated.

The completion of the branch of the Temiskaming and Northern Ontario railway from Earlton to Elk Lake in the latter part of 1912, caused a revival of mining activity in the Montreal River area. It also improved the shipping facilities for the Gowganda mines.

In the Gowganda area the principal shippers were the Miller Lake-O'Brien and Mann. The Millerett was formerly the main shipper, but this property was closed down during the year and was afterwards purchased by Mr. M. J. O'Brien, the owner of the Miller Lake-O'Brien mine.

Following is a brief description of the mines and more important prospects of Cobalt and the outlying silver districts that were in operation during 1912:—

Cobalt Silver Mines

Alexandra

The Canadian Gold and Silver Mining Company, E. W. Beidler, superintendent, reopened the Alexandra mine early in 1913 and have been carrying on exploratory work. The main shaft was formerly sunk to a depth of 310 feet. At the 65-foot level 75 feet of drifting has been done, and on the 300-foot level cross-cuts have been driven southeast and southwest 235 feet respectively.

Bailey

The Bailey Cobalt Mines, Limited, under Superintendent Floyd Weed, carried on work during the year on the southwest quarter of the north half of lot 4, in the fourth concession of Coleman, adjoining the Penn-Canadian mine.

The main shaft is now 232 feet in depth, and at this level 1,000 feet of drifting and cross-cutting have been done. Most of this work is on the north side of the claim. Considerable work has also been done on the first, second and third levels, as also on intermediate levels between the second, third and fourth levels.

Beaver

The Beaver mine, situated on the north half of the northwest quarter of the north half of lot 1, in the third concession of Coleman, is owned and operated by Beaver Consolidated Mines, Limited, which have an authorized capital of 2,000,000 shares of a par value of $1.00. The officers and directors are as follows:—

Frank L. Culver, president and general manager; C. C. James, vice-president; H. E. Tremain, secretary-treasurer; Wm. Muir, Thos. Mason, Geo. Glendinning, and F. C. Finkenstaedt, directors.

During the year the company purchased the Erie-Cobalt property, consisting of 40 acres, lying east of the Beaver, and also 75 per cent. of the stock of the Beaver Auxiliary Mines (Donaldson claims) at Elk Lake. At the latter property active development work is being carried on, and it is proposed to sink the shaft at the Erie an additional 100 feet.

The main shaft at the Beaver is now 730 feet in depth, with levels as follows: First at 75 feet; second at 200 feet; third at 250 feet; fourth at 300 feet; fifth at 350 feet; sixth at 400 feet; seventh at 460 feet; eight at 530 feet; ninth at 600 feet; tenth at 700 feet.

The manager reports the following development work and stoping for the year: Drifting, 3,414.5 feet; cross-cutting, 744.5 feet; sinking, 185.5 feet; raising, 157 feet, and 4,316 yards of stoping.

During the year the company shipped 689,921 ounces of silver. The capacity of the concentrating mill has been increased so that it has now a capacity of about 90 tons per day. During the year 17,842 tons of low-grade ore were milled, producing 278,511 ounces of silver.

Buffalo

This mine, situated on the townsite of Cobalt, is owned and operated by Buffalo Mines, Limited, which have an authorized capital of $1,000,000, the shares having a par value of $1.00. Mr. Chas. L. Denison, of New York, is president; Mr. Geo. C. Miller, secretary-treasurer, and Mr. Tom R. Jones, general superintendent.

Work was carried on underground according to the same plan of operations as outlined in former Reports. No. 6 shaft, sunk on the northerly vein series, near the mill, is the main hoisting shaft and is connected with cross-cuts on the first and third levels to the southerly vein system. The management report the following work done:—Shaft work, 86 ft.; drifting, 1,514 ft.; stoping, 56,931 cu. ft.

The Buffalo low-grade mill was operated continuously throughout the year and treated about 50,000 tons of ore. A plant for the treatment of high-grade ore and concentrates was erected during the year and the treatment of ore begun in November. The method is similar to that worked out by the Nipissing Mining Company for the treatment of their high grade ore.

Casey Cobalt

This property, situated on the southeast quarter of the south half of lot 5 in the first concession of Casey township, about 10 miles northeast of the town of New Liskeard, is controlled by the Casey Cobalt Mining Company, Limited, with an authorized capital of $100,000. During 1912 the company became an important producer, owing to the discovery of high-grade silver ore. The plant was enlarged by increasing the boiler capacity to 280 horse power and building a mill capable of handling 25 tons per day.

The main work has been done on the No. 6 vein, which was found about 125 feet northwest of the old workings and parallel to them. This vein has been drifted on for a distance of 250 feet on the 210-foot level and 150 feet on the 100-foot level. A new shaft has been sunk a depth of 260 feet on the southwesterly end of the vein.

Mr. W. R. P. Parker is president, and Mr. John Shaw, manager.

Chambers-Ferland

Mining work was continued by the Chambers-Ferland Mining Company, Limited, at their No. 1 shaft. This shaft is 200 feet deep. The work during the year was confined largely to the 150- and 200-foot levels. On the 200-foot level about 1,000 feet of drifting and cross-cutting were done, and 250 feet on the 150-foot level. Several raises were put up connecting the levels.

City of Cobalt

The City of Cobalt Mining Company Limited have a 99-year lease from the T. and N. O. Railway Commission of 40 acres of the townsite of Cobalt. The main shaft is 340 feet in depth. A winze was sunk during the year from a point on the 330-foot level, 360 feet east of the shaft, a depth of 70 feet, and several hundred feet of drifting and cross-cutting were done at the 400-foot level. The greater part of the workings are on the south part of the lot adjoining the Cobalt Townsite property on the north.

The company operated the King Edward mill during the year on their low-grade ore.

Cobalt Provincial

The Cobalt Provincial Mining Company carried on underground work during the year from No. 2 shaft. This shaft has been sunk to a depth of 360 feet, an increase of 60 feet. On this lower level 120 feet of drifting were done. On the 175-foot level a cross-cut has been driven northwest a distance of 600 feet. Some work was also done during the year on the other levels.

Cobalt Townsite

The Cobalt Townsite Mining Company Limited, with an authorized capital of $100,000, hold a 99-year lease from the T. and N. O. Railway Commission of the south 38 acres of the townsite of Cobalt. Mr. W. R. P. Parker, of Toronto, is president, and Mr. A. C. Bailey, superintendent.

The work during the year was confined principally to the northeast corner of the property, although some work was done on the southern part of the lot from No. 4 shaft. No. 1 shaft is 200 feet in depth, but a winze has been sunk at a point 240 feet south of the shaft a depth of 100 feet, and about 1,000 feet of drifting and cross-cutting done at the 300-foot level. A drift has been run north to the shaft preparatory to connecting the latter with the 300-foot level. Work has been continued on the 100 and 200-foot levels and stopes opened up on the different levels. The company have a contract with the Northern Customs Concentrators, Limited, for concentrating their low-grade ore, and about 100 tons per day were treated during the year.

Cobalt Lake

The property consisting of the bed of Cobalt lake and 33 feet of the road allowance on the east shore of the lake is owned and operated by the Cobalt Lake Mining Company, which have an issued capital of 3,000,000 shares of a par value of $1.00 each. The officers and directors of the company are as follows:—

Colonel Sir Henry Pellatt, president; Major J. A. Murray, vice-president; W. R. P. Parker, Hugh Blain, and Thos. Birkett, directors; G. F. Morrison, secretary-treasurer; M. B. R. Gordon, manager.

The manager reports the following underground work during the year: Drifting, 1,319 feet; cross-cutting, 1,885 feet; raising, 90 feet; winzes, 104 feet; shaft-sinking, 68 feet; stoping, 7,449 cubic yards. A connection was made during the year between the workings of No. 4 and No. 6 shafts which improves the ventilation and provides an auxiliary exit from the workings of both shafts. The vertical depth at which this connection was made was 236 feet. A drift has been driven along the fault on the lower level to a point underneath No. 6 shaft, and a vertical shaft is being raised. A winze is also being sunk to locate the fault vein 50 feet below the present lowest level.

The 20-stamp mill was operated throughout the year and 23,410 tons of ore treated, producing 541,570 ounces of silver, the total output of the mine being 1,123,146 ounces. The capacity of the mill is to be doubled by the installation of twenty additional stamps, a tube mill and the requisite number of concentrating tables.

Coniagas

The Coniagas Mines, Limited, having an authorized capital of 800,000 shares of a par value of $5.00, own and operate the Coniagas mine, consisting of 40 acres on the townsite of Cobalt, and the issued capital stock of the Coniagas Reduction Company, Limited. The Board of Directors are as follows:—R. W. Leonard, St. Catharines (president and general manager); Alex. Longwell, Toronto (vice-president); R. P. Rogers, Cobalt; F. J. Bishop, Brantford; Welland D. Woodruff, St. Catharines.

The company have paid to stockholders since incorporation $4,280,000, or $280,000 more than the total capital.

The assistant to the president reports that during the year the following underground work was done:—

Drifting	2,773 feet.
Cross-cutting	1,401 "
Winzes	112 "
Raises	298 "
Stoping	51,350 tons.

The total tonnage of ore milled was 53,627, or an average of 2.86 tons per stamp per 24 hours. The mill heads averaged 34.12 ounces per ton, the sand tailings 4.12 ounces per ton, and the slime tailings 7.29 ounces per ton.

The development work during the year was done on the 150-ft. and 225-ft. levels. A cross-cut was driven on the 225-ft. level to the southern boundary ot the property, a distance of about 850 feet.

Colonial

The Colonial mine is operated by the Colonial Mining Company. The shares of the company are owned by the Colonial Silver Mines, Limited, which have an authorized capital of 1,200,000 shares of a par value of $5.00 each.

Development work was carried on underground during the year, and sufficient stoping done to supply the 10-stamp mill.

Crown Reserve

The Crown Reserve Mining Company, Limited, having an authorized capital of 2,000,000 shares of a par value of $1.00 each, own and operated the Crown Reserve mine, Cobalt, and the McEnaney gold mine, Porcupine. The company also operated the Silver Leaf mine, Cobalt, under lease. The officers of the company are as follows: Lieut.-Col. John Carson, president; W. J. Gear, 1st vice-president; C. E. Potter, 2nd vice-president; Jas. Cooper, secretary-treasurer; S. W. Cohen, general manager.

The manager reports the following mine developments:—

	Up to 1912.	1912.	Total.
Sinking and raising	1,790 feet.	432 feet.	2,222 feet.
Drifting	5,247 "	1,973 "	7,220 "
Cross-cutting	5,172 "	2,184 "	7,356 "
Total	12,209 "	4,589 "	16,798 "

Stoping for 1912, 297,066 cubic feet.

The north shaft on the Silver Leaf property was sunk to a depth of 500 feet, and from this point a cross-cut was driven south 800 feet to connect with the Crown Reserve shaft at a depth of 450 feet. The ore production during the year came from the following veins: Carson, Nos. 14, 17, 24, 29, north and miscellaneous.

The company entered into a contract with the Dominion Reduction Company for treating their low-grade ore. The ore is taken by aerial tram from the mine to the works of the Dominion Reduction Company. The results of the concentration for the year show 15,704 tons milled, yielding 336,238 ounces of silver.

The Crown Reserve Mining Company and the Kerr Lake Mining Company have obtained the right to pump out Kerr lake, which will make available the ore above the 100-foot level, and allow development work to be carried on over the rest of the property.

Drummond

This mine comprises the northwest quarter of the north half of lot 2 in the fourth concession of Coleman, and adjoining parts of the bed of Kerr lake. The mine was owned and operated by the Drummond Mines, Limited, during 1912, but was sold early in 1913. The principal work done during the year was from No. 5 shaft, near the south boundary of the south lot. This shaft is 150 feet deep, with levels at 75 and 150 feet. A connection has been made on the first level from No. 5 shaft to No. 1 shaft, about 500 feet distant. On the second level, 750 feet of drifting and cross-cutting have been done.

The low-grade ore was treated by the Northern Customs Concentrator under contract.

Gould

The Gould Consolidated Mines, Limited, operated under lease from the Peterson Lake Silver Cobalt Mining Company on Cart lake. The shaft is 200 feet deep, and 200 feet of drifting and cross-cutting have been done at this level.

General Mines

The General Mines Limited were engaged in operating the Agaunico, Red Rock and Cobalt Contact properties during part of the year.

The Agaunico shaft is 275 feet deep. On the 200-foot level, drifts have been run southwest 265 feet and a cross-cut driven east 300 feet.

At the Red Rock, on the 50-foot level, a drift has been run northwest 80 feet.

At the Cobalt Contact, the main shaft is down 95 feet and is being sunk deeper. All work is now confined to the Cobalt Contact property.

Hargrave

Work was continued during the year by the Hargrave Silver Mines Limited on the two 40-acre claims described as the southwest quarter of the north half of lot 2 in the fourth concession and the northwest quarter of the south half of lot 3 in the fourth concession of Coleman. These claims adjoin the Drummond and Kerr Lake mines.

The company have an authorized capital of $2,500,000. Mr. W. N. Ferguson, of Toronto, is president, Mr. R. D. Moorhead, Toronto, secretary-treasurer, and Mr. E. V. Neelands, Cobalt, manager.

No. 1 and No. 3 shafts on this property remain the same depth, namely, 125 feet and 375 feet respectively. Exploratory work was carried on mainly on the lower level, where a cross-cut has been driven west along the north boundary of the south claim, a distance of 450 feet. Other exploratory work was done on the upper levels and also some stoping.

Hudson Bay

This property consists of 340 acres situated in the township of Coleman, and is operated by The Hudson Bay Mines, Limited, which have a capitalization of 3,500,000 shares of a par value of $1.00. Of this amount, 2,900,000 shares are owned by the Temiskaming and Hudson Bay Mining Company, Limited, which have an authorized capital of $25,000, of which 7,761 shares have been issued. The latter company paid $209,547 in dividends during their fiscal year, 1911-12. The officers and directors of this company are as follows:—

Geo. Taylor, president; A. A. McKelvie, vice-president; S. S. Ritchie, Jr., T. McCamus, T. Crawford, John Dunkin, and D. M. Ferguson, directors; F. L. Hutchinson, secretary-treasurer; A. H. Brown, general manager.

The company's total production for their fiscal year, 1911-12, amounted to 957,055 ounces, produced at a cost of 14.9 cents per ounce.

The manager's report shows that 1,195.8 feet of drifting and 1,653.9 feet of cross-cutting was done during the year at their main property, north of the Trethewey mine. A shaft was sunk to a depth of 100 feet and some 400 feet of drifting done on the lot southwest of the McKinley-Darragh and east of the railway track.

The 20-stamp mill of the company was operated throughout the year treating 21,439 tons of ore. The ratio of concentration was 30 to 1.

Kerr Lake

This mine is situated on the northwest part of lot 4, in the fourth concession of Coleman, and it is operated by the Kerr Lake Mining Company, Limited, which have an authorized capital of $40,000. The capital stock of the company is held by the Kerr Lake Mining Company, of New York, with an authorized capital of 600,000 shares of a par value of $5.00 each. Mr. J. A. Lewisohn is president, Mr. Willard P. Ward, vice-president; Mr. J. N. Susmann, secretary-treasurer; and Mr. Robert Livermore, mine manager. The company have paid in dividends to August 31st, 1912, $4,020,000.

The manager reports that, during their fiscal year, the following development work was done: Drifting, 4,674 feet; cross-cutting, 2,252 feet; raising, 609 feet; sinking, 197 feet; stoping, 31,782 cubic feet; total development work to date, 29,679 feet. Most of the work was done on the known veins in following and blocking out ore bodies, and on the north side of the property. Production from the veins tributary to No. 7 shaft was 1,479,894 ounces, and from No. 3 shaft, 261,910 ounces. In addition to this, there was a considerable production from mill ores. The company have an ore-sorting plant at No. 7 shaft consisting of trommels, jigs, and one Wilfley table. A contract was also entered into with the Dominion Reduction Company for treating low-grade ore, the ore being taken by an aerial tramway from the mine to the concentration mill, about one mile distant.

La Rose Consolidated

La Rose Consolidated Mines Company, Limited, own all the stock of the La Rose Limited, the Lawson Mines Limited, the Violet Mining Company, and 7,262 shares of the University Mines, Limited. The properties are as follows:—

La Rose Mines, Limited:	
La Rose (J. S. 14)	37 acres.
La Rose Extension	36 "
Princess	17 "
Fisher	20 "
Epiett	20 "
Silver Hill	93.5 "
University Mines, Limited:	
University	56 "
Violet Mining Company:	
Violet	40 "
Lawson Mining Company:	
Lawson	40 "
	359.5 "

The company have an authorized capital of 1,500,000 shares of a par value of $5.00 each. The officers and directors are as follows:—

D. Lorne McGibbon, Montreal, president; Shirley Ogilvie, Montreal, Edwin Hanson, Montreal, vice-presidents; E. W. Nesbitt, Woodstock, Victor E. Mitchell, Montreal, Duncan Coulson, Toronto, and W. M. Dobell, Quebec, directors; R. B. Watson, Cobalt, director and general manager; Stephen J. LeHuray, secretary-treasurer.

The total number of ounces of silver produced to December 31st, 1912, was 17,813,265.92, for which the company received $8,971,873.51.

The general manager gives the following summary of work done during 1912:—

Property	Shafts	Drifts	Cross-Cuts	Raises	Total	Stopes
	feet	feet	feet	feet	feet	cu. yds.
La Rose	167.5	2,059	1,454.5	72	3,753	8.413
Lawson	66	2,614.5	1.744	729.5	5,154	1,356
Princess	30	679.5	2,038.5	178	2,926	6.861
Fisher—Eplett	172.5	666	269	66	1.173.5	....
Violet	....	16	691	....	707	....
Total	436	6.035	6.197	1.045.5	13.713.5	16,630

The company have a contract with the Northern Customs Concentrator for milling their low-grade ore. This ore comes mainly from the La Rose and Princess, though a few carloads were also sent from the Lawson. The result of concentrating this ore was as follows:—

Ore treated	33,984.16 dry tons.
Silver contents of heads	556,612.79 ounces.
Average assay of heads	16.38 ounces.
Concentrates produced	1,173.5 dry tons.
Silver contents concentrates	487,423.7 ounces.
Average assay concentrates	415 ounces.
Net value concentrates	$259,018.62.
Cost of concentration	$102,072.49.
Cost per ton of ore	$3.00.
Profit to La Rose Mines, Limited	$156,946.13
Average tonnage for 313 days	168 tons.
Ratio of concentration	29 to 1.

According to the manager the most important exploratory work done during the year was the investigation of the La Rose fault. A winze was sunk 283 feet below the lowest levels of the mine, making the total depth from the surface 521 feet. Cross-cuts east and west were driven at the 380-foot level, and the east cross-cut encountered the fault in 115 feet, and drifts have been run along the fault a total distance of over 500 feet. The fault has also been reached at the lower level 230 feet from the shaft and about 200 feet of drifting done on it. It is the intention to sink a winze on the fault from the lower level.

The production from La Rose during the year was 852,525.98 ounces, in addition to concentrates.

The only work done on the Violet was to drive a cross-cut 700 feet in length north from the shaft.

The production from the Lawson during the year was 732,281.41 ounces. Exploratory work was carried on on the 188-, 238- and 300-foot levels.

The Fisher-Eplett claims are situated in the southern part of Coleman township north of and adjoining the Beaver. A shaft has been sunk to a depth of 200 feet and 1,173 feet of development work done. The shaft is now being sunk to the 300-foot level.

The production from the Princess during the year was 744,000 ounces. The main shaft was sunk to the third level and a winze has been started from this level on the No. 7 vein.

No work was done on the University during the year.

Lumsden

The Lumsden Mining Company were operating the property situated on the west half of the northeast quarter of the north half of lot 2 in the third concession of Coleman. The main shaft is 400 feet deep, and the work was carried on mainly on the 225- and 250-foot levels. A cross-cut has been driven east 150 feet on the 250-foot level, and the 225-foot level connected to the 300-foot by raises south of the shaft. About 350 feet of drifting and cross-cutting have been done on the 300-foot level.

Mr. John Lumsden, of Ottawa, is president of the company, and Mr. F. I. Daniels, manager.

McKinley-Darragh-Savage

The McKinley-Darragh-Savage Mines of Cobalt Limited, own and operate the McKinley-Darragh mine at the southern end of Cobalt lake and the Savage mine on lot 3 in the third concession of Coleman east of Cart lake. The officers and directors are as follows:—

C. A. Masten, Toronto, president; Thos. W. Finucane, Rochester, vice-president; J. R. L. Starr, Toronto, secretary; W. L. Thompson, Rochester, treasurer; Joseph D. Thompson, Rochester, assistant treasurer; Hiram W. Sibley, Rochester, and Harper Sibley, Rochester, directors; T. R. Finucane, Cobalt, manager.

McKinley-Darragh:—The following table from the directors' report shows the footage advance on the different levels throughout the year and the tonnage taken from the stopes:—

Levels	Drifts	Cross-cuts	Raises	Winzes	Stopes
feet	feet	feet	feet	feet	tons
110	467.5	215.5	19.5	....	9,007
125	43.5	....	....	....	252.5
150	1,527.5	826.5	150.5	100	13,434
200	594.5	282	128	....	8,092.5
230	2.5	....	....	....	....
250	449.5	495	39	....	1,010
Total.....	3,085	1,819	332	100	31,801

As will be seen from the above, the greater part of the development work was done on the 150-foot level or below it.

Savage:—The following table shows the underground work done at the Savage mine:—

Levels	Drifts	Cross-cuts	Raises	Winzes	Shafts	Stopes
feet	feet	feet	feet	feet	feet	tons
90	....	191	91.5	....	....	359.5
140	671.5	623.5	....	34.5	39.5	6,925.5
174	....	3.5	....	....	....	....
190	594	412	121.5	33	45.5	3,506.5
220	134	41.5	27	....	....	....
240	222	74	60.5	....	....	....
Total.....	1,621.5	1,345.5	300.5	67.5	85	10,791.5

The aerial tramway connecting the Savage with the McKinley-Darragh has been completed, and all the ore will in future be treated at the McKinley-Darragh.

During the year 51,897 tons of ore were treated at the mill, from which 1,489,514 ounces of silver were recovered. An additional 20-stamps and a tube mill are being added to handle the low-grade ore from the Savage mine.

Nipissing

The Nipissing Mining Company Limited, with an authorized capital of $250,000, own and operate 846 acres in the township of Coleman, principally situated in the producing area. Mr. David Fasken, of Toronto, is president; Mr. R. B. Watson, general manager, and Mr. Hugh Park, manager. The Nipissing Mines Company is a holding company, owning all the stock of the Nipissing Mining Company, and have an authorized capital of 1,200,000 shares of a par value of $5.00. The officers and directors of the company are as follows:—

E. P. Earle, New York, president; R. T. Greene, New York, secretary; W. H. Brouse, Toronto, Duncan Coulson, Toronto, David Fasken, Toronto, John L. Feeny, New York, August Heckscher, New York, Denis Murphy, Ottawa, and R. B. Watson, Cobalt, directors.

The general manager's report for 1912 shows the work done to be distributed as follows:—

Shaft No.	Drifting	Cross-cutting	Raising	Sinking	Total	Stoping
	feet	feet	feet	feet	feet	cu. yds.
8	....	....	....	99	99	....
63	463.5	955.5	72	....	1,491	3,109
64	139	121	117.5	230.5	608	994
73	3,133	1,168.5	500	93	4,894.5	5,656
80	1,082.5	1,554	491	77	3,204.5	3,726
86	....	....	....	20	20	....
122	1,250.5	416.5	303	32	2,002	2,015
128	....	....	....	....	....	264
150	37	457.5	....	206.5	701	....
Total.....	6,105.5	4,673	1,483.5	758	13,020	15,764

The general manager gives the following table of production of individual veins for 1912:—

Shaft 63 (veins 63, 108, 148, and Little Silver)	743,657	ounces.
Vein 64	268,627	"
Vein 73 (veins 73, 80, and 100)	3,264,126	
Vein 122	364,401	"
Vein 128	26,622	"
Vein 133	20,828	"
Total	4,688,261	ounces.

The hydraulic plant for surface prospecting was operated from May 8th to November 29th for 16 hours per day, and 33.2 acres of ground were cleared, the average depth of soil removed being 4.75 feet. The pressure is obtained from a turbine pump directly connected to a 650-horse power high-speed motor throwing 4,800 gals. per minute under a head of 415 feet. The average nozzle pressure obtained was 121 pounds.

As is shown by the above table, 13,020 feet of development work was done during the year as compared with 8,781 feet the previous one.

The shaft on vein 64 north of the town was sunk to a depth of 585 feet. A great amount of drifting and cross-cutting was done on vein 73, particularly on the third level. Shaft 86 on the west shore of Cart lake was reopened. Shaft 150, on the east shore of Cart lake, was sunk to the 300-foot level.

The Nipissing Reduction Company treated 13,893.9 tons of low-grade ore from the Kendall dump, recovering 123,037.24 ounces of silver at a cost of $38,176.51. The ratio of concentration was 95.9 to 1.

The general manager reports as follows regarding the low-grade mill:—

The cyanide plant erected for the treatment of the low-grade ore was completed in 1912, and is now in full operation. Part of the stamps were dropped in November, just a year after excavation began, but the whole mill did not go into full operation until after the first of the year. During February, 1913, the plant treated an average of over 200 tons per day and made a good recovery at less than the estimated cost per ton.

All the ore so far milled has come from the town side, being transported across the lake and to the top of the picking plant by an aerial tramway.

This central picking plant replaces the several similar plants at the individual shafts; the high grade ore is sorted from a travelling belt and the undersize of a 1½-inch screen is concentrated by jigs and two tables.

The first class ore and the concentrate produced by the picking plant are sent to the high-grade mill for treatment.

The discard and tailing from the picking plant are transferred to the crushing department of the main mill. There are 40 stamps of 1,500 lbs. each and four tube mills 6 feet in diameter by 20 feet long. Six Dorr classifiers are in a closed circuit with the tube mills and all the ore is slimed before it is transferred to the cyanide plant. The silver is precipitated out of the cyanide solution by aluminum dust. The precipitate as it comes from the press and after drying carries 93 per cent. silver. This is transferred to the refinery and melted down to bullion 999 fine in one operation.

The cost of the mill was $254,839.52; the crushing and picking plants, two tramways, roads and shops cost an additional $69,811.25, making the total expenditure $324,650.77.

The plant for the treatment of high-grade ore was in operation throughout the year, treating 1,753 tons of ore and producing bullion to the amount of 4,258,641 ounces. A complete description of this plant is given by Mr. R. B. Watson, entitled:—"Nipissing High Grade Mill," in the Engineering and Mining Journal (New York), Dec. 7th, 1912.

O'Brien

This mine is owned and operated by Mr. M. J. O'Brien. The several shafts on the property have now been connected underground with the central 3-compartment shaft near the mill and the mill ore hoisted through this shaft. No material change has been made during the year in the depths of the several workings, but about 4,000 feet of drifting and cross-cutting were done and 15,000 yards of stoping. The mill was was operated continuously throughout the year.

Penn Canadian

The Penn Canadian Mines, Limited, have taken over the property originally worked by the Cobalt Central Mining Company, and operated both mine and mill for part of the year. Considerable new work was done on the fourth and fifth levels of the mine and stoping carried on, on the upper levels.

Mr. B. W. Neilly is superintendent in charge.

Peterson Lake

The property of the Peterson Lake Silver Cobalt Mining Company, Limited. consists of about 200 acres, made up of the bed of Peterson lake and 33 feet of the road allowance around the lake. Sir Henry Pellatt is president, and Mr. G. F. Morrison, secretary-treasurer.

The Seneca Superior Mining Company and the Gould Consolidated Mining Company have leases on part of the area. Very little mining work was done by the company during the year. A new shaft was started just north of the narrows between Cart and Peterson lakes. This shaft is now down 80 feet.

Ophir

A little development work was done by the Ophir Cobalt Mines Limited, on the east half of the northeast quarter of the north half of lot 2, in the second concession of Coleman. The shaft is 300 feet deep, but most of the work was done on the 180-foot level.

Right of Way

The Right of Way Mining Company confined their operations during the year chiefly to the workings from No. 4 shaft west of the McKinley-Darragh mine. The shaft remains the same depth, but some drifting and cross-cutting was done and stoping carried on, on veins previously opened up.

The president of the company is Mr. Geo. Goodwin, and the superintendent Mr. R. F. Taylor.

Seneca-Superior

The Seneca-Superior Silver Mines Limited, have taken over the leases on Peterson and Cart lakes, formerly held by the Kerry Mining Company. Operations have been confined to the Cart lake lease, where a good vein was encountered in the latter part of 1912. No. 1 shaft is 200 feet deep with the main cross-cut north, 800 feet in length to the north shore of the lake, where a raise is being put through to the surface. On the vein encountered 450 feet from the shaft 400 feet of drifting has been done and some stoping. A shaft and ore-sorting house have been erected.

Silver Bar

Work was resumed on the Silver Bar mine, Coleman township, by the Preston-East Dome Mining Company. No. 1 shaft is 80 feet deep with a drift 200 feet west to connect with old workings on the 50-foot level. No. 2 shaft is 100 feet deep with 300 feet of drifting on the 50-foot level, and a 50-foot cross-cut on the 100-foot level. Mr. Stuart M. Thorne is in charge of operations.

Silver Cliff

This property has been taken over by the Orion Realty and Investments Limited. No work was done on it during 1912.

Temiskaming

This property, consisting of the south half of the northeast quarter and the west half of the southwest quarter of the north half of lot 1, in the third concession of Coleman, is owned by the Temiskaming Mining Company, which have an authorized capital of 2,500,000 shares of a par value of $1.00. The officers and directors of the company are as follows:—

Burr E. Cartwright, Buffalo, president; J. L. Wheeler, Marion, S.C., vice-president; Alex. Fasken, Toronto, secretary-treasurer; R. A. Cartwright, Ridgeway, Pa., Ernest C. Whitbeck, Rochester, N. Y., and Wallace Thayer, Buffalo, N.Y., directors; Norman R. Fisher, Cobalt, general manager.

The main 3-compartment shaft is 650 feet in depth. The mining work during the year was made up as follows: shaft-sinking, 36.5 feet; winzes, 87.5 feet; raises, 527.4 feet; drifting, 2,687.9 feet; cross-cutting, 936 feet; and 11,644 cubic yards of stoping. The total lineal footage of work done underground since the commencement of operations amounts to 17,455 feet, and the stoping to 33,868 cubic yards.

Seneca-Superior silver mine and plant.

Work was carried on during the year on all the levels of the mine.

The manager reports the occurrence of a good vein of silver on the 650-foot level in the diabase sill which underlies the Keewatin.

The mill treated 40,056 tons of 22.6-ounce ore and recovered 744,370 ounces of silver. The ratio of concentration was 45 to 1.

The concentrates shipped by the company were found to contain 16,037 pounds of copper for which $1,133 was received from the smelter.

Trethewey

This property is owned and operated by the Trethewey Silver Cobalt Mine, Limited, which have an authorized capital of 2,000,000 shares of a par value of $1.00, of which 1,000,000 shares have been issued.

The officers of the company are as follows:—

Alex. M. Hay, Haileybury, president; Sidney Small, Toronto, vice-president; David Fasken, Toronto, W. J. Sheppard, Waubaushene, Jas. B. Tudhope, Orillia, and S. R. Wickett, Toronto, directors; D. L. H. Forbes, Toronto, consulting engineer; H. G. Young, Cobalt, manager.

The development work during the year is as follows:

Drifting	2,072.5 feet.
Cross-cutting	877.5 "
Raises	788.5 "
Winzes	68.0 "
Shaft-sinking	79.0 "
Total	3,885.5 feet.

The total development work done to the 31st December, 1912, amounts to 18,234.5 feet. All of the shafts remain the same depth as given in the last Report, with the exception of No. 6 which was sunk an additional 79 feet to the second level, where 350 feet of drifting was done. The rest of the development work was done from the old levels, and consisted of following known veins and cross-cutting to prospect for veins in new ground.

The mill has run continuously throughout the year, treating approximately 2,450 tons per month. A number of changes have been made in the mill with the view of obtaining a better recovery of silver from the milled product.

United States

On the north half of lot 2, in the fifth concession of Coleman the United States Cobalt Mining Company, under Superintendent A. A. Amos, have driven in an adit 140 feet.

Aladdin (Silver Queen)

The old Silver Queen mine has been taken over by the Aladdin Cobalt Mining Company and has been unwatered, and 700 feet of drifting done on the 200-foot level east and west of the shaft. Some drifting has also been done on the 75-foot level.

York Ontario (King Edward)

This mine is now being worked by the York Ontario Silver Mines, Limited. It was taken over by the new company the last of the year, and some work done on the 70- and 140-foot levels. A diamond drill hole was also put down from the bottom of the 450-foot shaft to test the depth of the diabase formation.

Cobalt Custom Mills

Dominion Reduction Company

This company have taken over the old Nova Scotia mill, and are treating low-grade ore from the Crown Reserve and Kerr Lake. Some changes have been made in the methods of treatment. The concentrates are now reground in a tube mill and subjected to separate cyanidation.

Nipissing Reduction Company

This company were engaged during the year in treating ore for the Nipissing Mining Company. A little ore was also treated for the Cobalt Lake, Green-Meehan and Silver Queen mines. The same system of water concentration as formerly described is followed.

Northern Customs Mill

The Northern Customs Concentrator, Limited, is an independent company operating the largest customs concentrating mill in Canada, and has also the greatest capacity of any mill in the Cobalt camp. Mr. A. J. Young is president, Mr. F. J. Bourne, consulting engineer, and Mr. M. F. Fairlie, superintendent. The mill is situated in Cobalt, south of the railway station.

The company have a contract from La Rose Mines, Limited, Cobalt Townsite Mining Company, Limited, and Drummond Mines, Limited, for treating their low-grade ores. During the year they handled about 65,000 tons of low-grade ore averaging from 15 to 20 ounces of silver to the ton.

The company now have 120 1,250-pound stamps for crushing the ore, 30 Wilfley tables, 24 vanners and 3 slime tables.

South Lorrain

Bellellen

On R. L. 470 the Bellellen Silver Mines Limited have been engaged part of the year in carrying on development work. All work is confined to No. 2 shaft, which is 100 feet deep with drifts west 56 feet and south 120 feet. A winze 35 feet deep has been sunk from the south drift and a drift started north from the bottom of this winze.

Curry

On H. R. 104, adjoining the Wettlaufer on the southwest, the Pittsburg Lorrain Syndicate have been engaged in development work under consulting engineer J. A. Rice. An incline shaft has been sunk 271 feet, and a cross-cut driven 45 feet to connect with the Wettlaufer workings.

A plant consisting of a 4-drill compressor driven by a 75-h.p. motor and hoist has been installed.

Keeley

No work was done on Keeley mine during 1912. Early in 1913 the Huronian Belt Syndicate took an option on the mine and began to unwater it.

Wettlaufer Lorrain

The Wettlaufer was the only shipper in South Lorrain during 1912. It is owned and operated by the Wettlaufer Lorrain Silver Mines, Limited, which has an authorized capital of 1,500,000 shares of a par value of $1.00.

The main shaft has been sunk to the fourth level, a depth of 250 feet. At a point 210 feet southwest of the shaft a winze has been sunk to the second level a total depth from the surface of about 500 feet. On the fifth level drifts have been run northeast and southwest of the winze distances of 70 and 180 feet and on the seventh level 120 and 130 feet respectively.

The mill has a capacity of about 30 tons per day. A Huntingdon mill is used for grinding the jig tailings.

Elk Lake Area

Beacon

On the northwest quarter of the north half of lot 4, in the first concession of James, the Beacon Consolidated Mines, Limited, were engaged during the year in development work. A shaft was sunk a depth of 200 feet, and 500 feet of drifting and cross-cutting done. A plant consisting of two boilers of 50- and 60-h.p. capacity, a 3-drill compressor and hoist were installed.

Beaver Auxiliary

This property is situated on part of lot 10 in the sixth concession of James, about two miles north of the town of Elk Lake, and was formerly known as the Donaldson. It is owned and operated by the Beaver Auxiliary Mines Limited, of which the Beaver Consolidated Mines Limited own 75 per cent. of the stock.

Two shafts have been sunk to depths of 107 and 142 feet respectively, and sinking is being continued in the first mentioned shaft. A plant consisting of two 90-h.p. boilers, an 8-drill compressor and hoist has been installed.

Fleur De Lis

On the northwest quarter of the north half of lot 7 in the first concession of Smythe the Fleur de Lis Silver Mining Company have been engaged in development work. A shaft has been sunk a depth of 120 feet.

Moose Horn

Very little work was done by the Moose Horn Mines, Limited, during 1912, but active operations were resumed early in 1913. A cross-cut is being driven from the 125-foot level west to cut the vein showing on the surface.

Patricia

On part of lot 2 in the second concession of James the Patricia Mines, Limited, have sunk a shaft a depth of 44 feet. The plant used consists of a 20-h.p. boiler and hoist.

Prudential

On parts of lots 4 and 5 in the sixth concession of James the Prudential Mining Company have sunk a shaft 125 feet deep.

Regal

On the southeast quarter of the south half of lot 9 in the sixth concession of James the Regal Mines, Limited, have been engaged in sinking a shaft. This shaft is now 250 feet in depth with 75 feet of cross-cutting at the 200-foot level. The plant consists of a 50-h.p. boiler and hoist.

Gowganda Area

Hudson Bay

The Hudson Bay Mining Company have been developing a property near Hanging Stone lake, south of Gowganda. Two shafts have been sunk, one to a depth of 110 feet and the other 200 feet. On the 80-foot level of the first shaft 160 feet of drifting has been done. On the first level of the deeper shaft drifts have been run east and west 120 feet and 150 feet respectively, and on the second level cross-cuts have been driven north 70 feet and south 110 feet.

La Brick

On the west shore of Gowganda lake, just east of the Mann mines, the La Brick Mining Syndicate have been carrying on development work under Superintendent G. R. Rogers. The main shaft is 200 feet in depth. On the 100-foot level a drift has been run northeast 100 feet, and on the 200-foot level drifts run northeast 200 feet and southeast 104 feet.

The plant consists of two 50-h.p. boilers, a hoist and compressor developing 500 cubic feet of air per minute.

Mann

The development work at the Mann Mines during 1912 opened up an ore body, and a shipment of ore was made. No. 3 shaft is 90 feet deep; on the 80-foot level drifts have been run east and west 200 feet respectively. At 90 feet west of the shaft a winze has been sunk 46 feet and drifts are being run from it east and west on the vein. Some stoping has been done below the 80-foot level. The Mann Mines, Limited, have taken over the Boyd-Gordon mine lying to the west of the Mann, and the power plant at this mine is used to supply power for operating the Mann mines.

Mr. Geo. R. Rogers is superintendent, employing a force of 45 men.

Miller Lake-O'Brien

This mine is now the largest shipper in the Gowganda area. The Millerett mine adjoining the Miller Lake-O'Brien, was purchased by the owners of the latter during 1912. The mill on it will be utilized for treating the low-grade ore.

The main shaft is 250 feet in depth. From a point 135 feet south of the main shaft on the 250-foot level a winze has been sunk 50 feet, and 160 feet of drifting and some cross-cutting done. Stoping is now being carried on, on both the 250- and 300-foot levels.

Oliver

About two miles south of Neilson's roadhouse in the township of Lawson a shaft has been sunk a depth of 90 feet by the Oliver Silver Mining Company. The shaft is being sunk by contract.

Powerful

On mining claim H. R. 397, in the township of Lawson, the Powerful Mining Company have continued development work. An adit has been driven 700 feet, a winze sunk 50 feet and a raise to the surface started.

Mr. J. E. Wilson is superintendent, employing 16 men.

Scottish Nigeria (Bartlett)

Work was resumed on what was formerly known as the Bartlett by the Scottish Nigeria, Limited. Only a few men are employed underground in development work.

South Bay

On claims H.F. 225 and H.S. 125 and 124, in the township of Milner, south of Gowganda lake, the South Bay Mining Company have erected a 16-h.p. boiler and hoist and sunk a shaft a depth of 80 feet.

Willing

Near Gowganda, in the township of Charters, the Willing Mining Company have sunk a shaft a depth of 88 feet.

Dane and Larder Lake Area

Dane Copper Mine

The Dane Mining Company were operating part of the year on claims near the southwest corner of Lebel township, three miles north of Dane station. A force of 22 men was employed under Superintendent Alex. D. McPhee. Two shafts have been sunk to a depth of 100 and 113 feet respectively, with some cross-cutting at the 50- and 100-foot levels to the deeper shaft.

The plant consists of two 100-h.p. boilers, one 75-h.p. boiler, a 6-drill compressor and two hoists.

Goldfields

The only property on which active work was carried on during the year at Larder Lake was the Goldfields Limited. Here the 30-stamp mill was completed and in operation part of the year. Electrical power is obtained from the company's own hydro-electric plant at Raven Falls.

The mine is being opened up by an incline shaft to the 65-foot level where drifts and cross-cuts are run and raises put through to the surface. It is the intention of the company to open-cut the ore body. A force of 28 men is employed under Manager E. T. Brooks.

Cartwright

On the north half of lot 8 in the fifth concession of the township of Beatty the Cartwright Goldfields are carrying on development work on a gold property. A shaft has been sunk a depth of 35 feet.

The plant consists of a 50-h.p. boiler, a 3-drill compressor and hoist.

Swastika and Kirkland Lake Gold Area

The greatest activity during the winter was in the Kirkland lake district, which lies about six miles to the northeast of Swastika. Some very rich gold ore has been shipped from the Foster property, and considerable prospecting work is being done throughout the area. At Swastika stamp mills have been erected at the Lucky Cross and Swastika mines.

Foster

Mr. C. A. Foster, of Haileybury, has purchased five claims in the townships of Teck and Lebel, near Kirkland lake, and has been carrying on development work. A shaft has been put down on the vein to a depth of 115 feet, and some ore taken out of an open cut along the vein. From the open cut and shaft 73.85 tons of ore have been shipped, yielding 1,636.87 ounces of gold and 2,300 ounces of silver. A 5-stamp mill has been erected on the property about 320 feet from the shaft.

The power plant consists of two 40-h.p. boilers, and a hoist, and a 4-drill compressor.

Mr. C. A. O'Connell is manager, employing a force of 40 men.

Lucky Cross

The Lucky Cross Mines, Limited, own three claims in the township of Teck situated south of and adjoining the Swastika townsite. The main shaft has been sunk to a depth of 200 feet. On the 100-foot level, drifting and cross-cutting has been done in addition to that outlined in the last Report, and a raise put up a distance of 40 feet near the shaft. A 5-stamp mill has been erected, and it was expected that it would be put in operation early in 1913.

Swastika

The property of the Swastika Mining Company, Limited, is situated about one-third of a mile west of the townsite of Swastika. The company have an authorized capital of 2,000,000 shares of a par value of $1.00. Dr. M. Steele is president, Mr. Jas. Clark, secretary-treasurer, and Mr. John Redington, manager.

A three-compartment shaft has been sunk to a depth of 400 feet, where a station has been cut and a cross-cut driven west 60 feet. On the 300-foot level, 420 feet of drifting and cross-cutting have been done, and on the 200-foot level, 360 feet of drifting and 220 feet of cross-cutting. In addition to this, considerable work was done on the 35-foot and 100-foot levels.

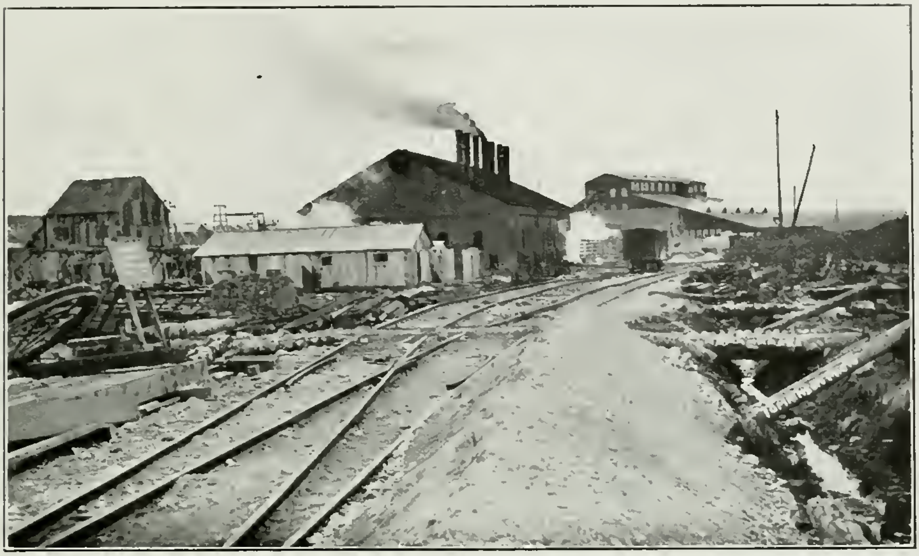
A 10-stamp mill was being erected the latter part of the year, and it was expected that it would be in operation early in 1913.

Teck

On the southwest side of Kirkland lake, on claims L. 1238, 1239, and 1240, in the township of Teck, the Teck Hughes Gold Mines Limited have commenced development work. Most of the work done consists of surface trenching and prospecting, but a shaft has been sunk 35 feet. A small plant is being erected.

Porcupine Gold Area

Satisfactory development work has been carried on during the year by a large number of companies in the Porcupine area during 1912. Four mills were in operation part of the year, and one of the companies went on a dividend basis the latter part of the year. Operations were seriously interfered with by a strike of the Porcupine branch of the Western Federation of Miners, which was declared in November, and has now been in progress six months. The miners asked for an 8-hour day and a higher scale of wages. A number of the smaller companies were forced to suspend operations, and, as a result, development work has been considerably retarded.



Dome mill, showing power house and mill.

Dome stamp mill.

Apex

The Apex Porcupine Mines Limited carried on development work on parts of lots 6 and 7, in the first concession of Tisdale, under Superintendent E. S. Sawyer. Two shafts have been sunk to a depth of 65 and 100 feet respectively.

Dome

The properties of the Dome Mines, Limited, are situated on the north half of lot 4, in the first concession of Tisdale. The company have an authorized capital of 350,000 shares of a par value of $10.00. The stockholders at their annual meeting in May, 1913, authorized an increase of the capital to 500,000 shares, and the issuing of sufficient stock to provide for the installation of sixty additional stamps in the mill, and the necessary auxiliary plant. The officers of the company are: Mr. Ambrose Monell, president; Mr. W. W. Mein, consulting engineer; Mr. R. M. Meek, general superintendent. The Merrill Metallurgical Company are consulting metallurgists.

For the year ending March 31st, 1913, the company mined and milled 101,812 tons of ore, of a total value of $1,043,994.93. The results were as follows:—

Tons milled	101,812
Yield by amalgamation	$560,481.62
Yield by cyanidation	$483,513.31

Dome Extension mine.

Total value	$1,043,994.93
Percentage of gold recovery	95.63
Mining costs	$157,666.27
Milling costs	$214,788.15
General expenses	$131,096.72
Marketing and miscellaneous	$30,487.83
Total cost	$534,038.83
Net earnings	$509,956.10

The production for the year has come largely from the open pit above the 45-foot level. The incline shaft from the mill has been extended to the 100-foot level. This level is being blocked out similarly to the 45-foot level, and will be mined by open-cut work. The No. 2 shaft is 257 feet deep with a cross-cut driven south 200 feet.

The company used steam power during the year, but are now operating by hydro-electric power supplied by the Northern Canada Power Company from their plant at Wawaitan Falls.

The method of extraction of gold in the mill is essentially the same as described in the last Report of the Bureau of Mines.

Dome Extension

Development work was carried on at the Dome Extension Mines during the year. No. 1 shaft is 222 feet deep, and on the 200-foot level a cross-cut was driven northwest 650 feet. From this cross-cut, 500 feet from the shaft, drifts have been run southwest 360 feet and northeast 300 feet. Drifts have also been run east from the shaft 540 feet and west 130 feet. No. 4 shaft is 100 feet deep. On this level, 500 feet of drifting and cross-cutting have been done.

Dome Lake

The Dome Lake Mining and Milling Company have sunk four shafts to a depth respectively of 60, 200, 110 and 130 feet. The three deepest shafts are on the same vein and are about 300 feet apart. The central shaft has three compartments and is connected with the west shaft on the 60-foot level, and with the east shaft on the 110-foot level. About 2,000 feet of drifting and cross-cutting have been done.

A 10-stamp mill has been erected and is equipped with one tube mill and four concentrating tables.

Hollinger mine, showing shaft house and mill.

Hollinger

The holdings of the Hollinger Mines, Limited, consist of four 40-acre claims, comprising the east half of the north half and the northeast quarter of the south half of lot 11, and the northwest quarter of the south half of lot 10, in the second concession of Tisdale.

The company have an authorized capital of $3,000,000, divided into 600,000 shares of a par value of $5.00. Mr. Noah Timmins is president, Mr. D. A. Dunlap, secretary-treasurer, and Mr. P. A. Robbins, general manager.

The Hollinger Mines, Limited, was the first of the Porcupine companies to go on a dividend basis. On November 3rd, 1912, a three per cent. dividend was declared, and since that date regular dividends of three per cent. have been declared every four weeks. This is equivalent to 39 per cent. per annum, and will mean a distribution of $1,170,000 per year to shareholders.

A 4-compartment shaft has been sunk to the 200-foot level, and two winzes sunk from the 200-foot to the 300-foot level.

The manager reports the total underground work done during the year ending December 31st, 1912, to be as follows:—

Level.	Drifts.	Cross-cuts.	Winzes.	Raises.	Shafts.	Stopes.
feet.	feet.	feet.	feet.	feet.	feet.	tons.
100	1,802	401	121	60	....	23,973
200	1,299	820	203	90	66	6,767
300	179	160	....	....	....	....
Total....	3,280	1,381	324	150	66	30,740

For the year 1912, the company mined and milled 45,195 tons of ore of a total value of $933,682, or an average value of $21.44 per ton.

Hollinger Reserve

On claims Nos. 44, 45 and 46, in the township of Ogden, the Hollinger Reserve Mining Company were engaged during the year in development work. The main shaft was sunk to the 200-foot level, and 200 feet of drifting and cross-cutting done on the 100-foot level and 250 feet on the 200-foot level.

The plant consists of two 60-h.p. boilers, a 6-drill compressor and hoist. Mr. W. Evans is superintendent, employing 25 men.

Hughes

On parts of lot 10, in the fourth concession of Whitney, the Hughes Porcupine Mines, Limited, were carrying on development work, and have erected a 2-stamp mill. The main shaft is down 200 feet, with 75 feet of drifting and cross-cutting on the 100-foot level, 165 feet on the 150-foot level, and 95 feet on the 200-foot level. Mr. E. H. York is superintendent, employing 26 men.

Jupiter

The Jupiter Mines, Limited, were engaged during the year in developing their property on the north shore of Pearl lake. No. 1 shaft is 100 feet in depth. On the 200-foot level, 400 feet of drifting has been done and 250 feet of cross-cutting, and on the 100-foot level, 300 feet of drifting and cross-cutting. Some drifting was also done on the 50-foot level. No. 2 shaft, 460 feet east, near the east boundary of the property, is 300 feet deep. On the 200-foot level, 150 feet of drifting and cross-cutting have been done. On the 300-foot level, a drift has been run west 200 feet and a cross-cut north 250 feet. At a point 160 feet north of the shaft, a drift has been run west towards No. 1 shaft, a distance of 400 feet.

The company purpose erecting a 10-stamp mill during the summer of 1913.

McEnaney

The McEnaney mine is owned and operated by the Crown Reserve Mining Company. A summary of mine development for the year is as follows:—

Sinking and raising	415 feet.
Drifting	1,222 "
Cross-cutting	738 "
Total	2,375 " .

The shaft has been sunk to a depth of 417 feet, with levels every 100 feet. The vein has been drifted on on each of the three upper levels for a distance of approximately 400 feet and a cross-cut driven to the vein on the fourth level.

A 5-stamp mill has been erected to treat 40 to 50 tons of ore per day. The method of treatment is as follows:—

The ore goes directly into a gyratory rock breaker for the preliminary crushing, then into the stamps, where it is crushed to 1-6th of an inch, and prepared for the fine crushing in the tube mill which follows. Between the stamp and the tube mill, a shaking screen has been put in, with the idea of getting out the fine material capable of being amalgamated at that point. The product from the tube mill goes to a Dorr classifier, the over-size of which is returned to the tube mill; the fine product finally going over a series of amalgamating plates.

McEnaney gold mine.

McIntyre

The McIntyre Porcupine Mines, Limited, have done extensive development work on their holdings at the west end of Pearl lake. The company also own part of the beds of Pearl and Gillies lakes. Most of the mining work during the year was done from Nos. 1 and 4 shafts on the south side of the lake. No. 1 shaft is 300 feet deep, and No. 4 shaft 200 feet. The new development work was done largely on the 300-foot level, and consisted of 300 feet of drifting and 200 feet of cross-cutting. Stoping has been carried on during the year on No. 1 vein chiefly above the first level. The company's 10-stamp mill was in operation the greater part of the year. The latter part of the year the company started work on a 300-ton mill, and the first unit was completed and put in operation in April, 1913. In this mill it is proposed to do the crushing by rolls and Chilian mills and cyanide the whole product.

North Dome

On parts of lots 3 and 4, in the first concession of Tisdale, the North Dome Mining Company carried on development work throughout the year. Shaft B is sunk to a depth of 50 feet. The main shaft, 325 feet northeast, is 250 feet deep and is connected with shaft B on the 50-foot level. On the 250-foot level, 150 feet of drifting has been done. The Temiskaming Mining Company own a controlling interest in this company.

Pearl Lake

The Pearl Lake Gold Mines, Limited, confined their operations during the year to the sinking of their main 3-compartment shaft. This shaft is now 700 feet in depth. On the 400-foot level a cross-cut was driven south 270 feet, and 130 feet of drifting done on the vein encountered 230 feet from the shaft. A cross-cut is also being driven on the 600-foot level. A new plant was put in operation consisting of a 12-drill electrically driven compressor and a double-drum hoist.

McIntyre gold mine.

North Dome mine.

Plenaurum

At the easterly end of Pearl lake the Plenaurum Mines, Limited, have sunk two shafts, No. 1 to the north of the lake, and No. 2 to the east. These shafts are about 1,000 feet apart, and have been sunk to a depth of 200 feet and connected at this level. Some drifting has been done on veins encountered, and a winze sunk a depth of 60 feet on a vein near No. 2 shaft. Another cross-cut was run north from No. 1 shaft a distance of 400 feet.

Schumacher

South of Pearl lake a shaft has been sunk on the Schumacher property a depth of 110 feet, and a drift driven north 240 feet and south 270 feet. The north drift ran into loose ground and a cave-in occurred. A concrete bulkhead was put in just north of the shaft to recover the workings. Mr. J. C. Houston is the manager of the mine.

Vipond mill and shaft house.

Three Nations

On lot 5 in the fifth concession of Whitney the Porcupine Three Nations Gold Mining Company, Limited, have continued exploratory work, and have sunk their shaft to a depth of 100 feet with 100 feet of drifting and cross-cutting at this level.

Vipond

The main shaft of the Vipond Porcupine Mines Company, Limited, has been sunk to a depth of 325 feet. The following work has been done underground: On the 100-foot level, 670 feet of drifting and 540 feet of cross-cutting; on the 200-foot level, 1,000 feet of drifting and 550 feet of cross-cutting; on the 300-foot level, 350 feet of drifting and 450 feet of cross-cutting.

The new mill was put in operation early in July, 1912, and was closed down in October. It has a capacity of about 100 tons per day, and is equipped with jaw crusher, rolls, Hardinge ball and pebble mills and classifiers. The ore is crushed to about 200-mesh and amalgamated on plates.

IV—EASTERN ONTARIO

Eastern Ontario attracted more attention from mining men during 1912 than for some years. The agitation for good roads has caused attention to be drawn to this area for a supply of suitable rock for road-building. Trap rock, or diabase, is acknowledged to be the most durable for macadamized roads, and the occurrence of this rock near Havelock, within easy haul of the more thickly populated section of the Province, has caused the opening of a quarry at this place. A number of limestone quarries have also been opened up, producing both building and crushed stone.

Iron

Belmont

The Buffalo Union Furnace Company have been operating the Belmont mine, formerly known as the Ledyard mine, situated on the west half of lot 19 in the first concession of Belmont township in the county of Peterborough. A 3-compartment vertical shaft has been sunk a depth of 230 feet. On the first level at 100 feet in depth drifts have been run northeast 100 feet and southwest 100 feet. On the second level at 170 feet, 50 feet of drifting has been done north and south of the shaft, and on the third level at 230 feet, about 25 feet of drifting.

Air for running the drills and hoist is obtained from the Cordova Mines, Limited. Mr. Frank Platto is superintendent, employing 42 men.

Canada Iron Mines, Limited

The Canada Iron Mines, Limited, have opened up the Bessemer, or Mayo mine, situated on lot 4 in the sixth concession of the township of Mayo, and the Childs mine, three miles northeast of Bessemer on lot 11, in the ninth concession of the same township. The Rankin-Coe property, on lot 10 in the ninth concession of Mayo township was worked under lease until January 1st, 1913. Ore from the Bessemer and Childs properties is shipped to the company's concentrator at Trenton.

Mr. W. D. P. Motter, of Trenton, is manager of both the mill and the mines.

Bessemer Mine

Work is confined at this mine to the No. 4 shaft, where development work only is being done except on the second level where stoping is being carried on. The shaft is 250 feet deep with levels at 60 feet, 115 feet, 175 feet and 250 feet. At the lowest level the station is being cut. On the third level drifts have been run northeast 155 feet and southwest 215 feet. Two raises are being driven from this level and are up 40 feet. On the second level the main drifts northeast and southwest of the shaft are run 125 feet and 375 feet, respectively. Considerable stoping has been carried on southwest of the shaft on this level; also to the northwest, where raises have been put through to the bottom of the old open pit.

Mr. W. J. McLaughlin is manager, employing 90 men.

Child's

This property was first opened up some years ago by the original holders, the Mineral Range Mining Company. The present owners have diamond-drilled it, and are taking out ore from two open cuts 300 feet apart. The ore is hauled in three-ton cars by "dinky" engines to the incline, where it is hoisted and dumped into a gyratory crusher. The product of this crusher goes to bins from which it is loaded directly into railway cars.

The plant consists of one 80-h.p. locomotive type boiler, one 80-h.p. return tubular boiler and hoist. The standard railway track has been extended from Bessemer to this property.

Coe and Rankin

This prospect was worked under lease with option to purchase by the Canada Iron Mines, Limited, until January 1st, 1913. The ore body was stripped for a distance of 300 feet long by 75 feet wide.

Concentrating Plant

The Canada Iron Mines, Limited, have erected at Trenton a magnetic concentrator for treating the ores from their Bessemer and Childs mines.

The ore is received from the mine, crushed to 2½-inch in standard hopper-bottom cars, and dumped into bins. It is fed out of the bins on a conveyor to a shaking screen at the top of the mill, this screen having ¾-inch openings. The oversize from the screen goes to the mill bins. The product from the bins is elevated and discharged into a trommel making 4 sizes and oversize. The fine product goes direct to the magnetic separator. The three coarse sizes go to three Ball-Norton drum separators. The middlings from these are re-crushed on a second set of 14 by 42-inch rolls and sent back to the separator. The capacity of the ore unit is 20 tons per hour.

The machinery in the mill is driven by electricity purchased from the Trenton Electric Company, and consists of an 85-h.p. motor running the mill, a 7½-k.w. motor-generator-set supplying 110-volt d.c. current for the magnetic separator and four 7½-h.p. motors running the conveyor and shop machines.

Orton

Work has been continued at the Orton mine by Mr. J. W. Evans and associates. The ore body is being stripped, and some ore has been shipped for experimental purposes.

Gold

Cordova Gold Mine

Work was carried on during the year by the Cordova Mines, Limited, at No. 3 shaft of this mine, and also at No. 1 shaft, which was timbered to the first level. The fifth level at 485 feet in depth was opened up at No. 3 shaft, and stopes opened up, both east and west of the shaft. Stoping was also being carried on on the 385-foot level, where the stopes have been carried up about 60 feet. The 30-stamp mill was in operation part of the year.

Mr. P. Kirkegaard is manager, employing about 60 men.

Golden Fleece

This mine, situated on the west half of lot 24 and on lot 25 of the sixth concession of the township of Kaladar, is owned by the Adelaide Mining Company of Baltimore, and is operated under lease, with option to purchase, by the A. B. P. Mining Company. The officers of this company are Mr. A. B. Potter, president and manager, Flinton; Mr. J. L. Potter, treasurer, and Mr. E. V. MacMillan, secretary, Toronto.

The underground development done at the property consists of a shaft 85 feet deep with a level at 65 feet On this level a drift has been run north 75 feet and a cross-cut 45 feet. The present operators have abandoned the shaft for the present, and are confining the work to the open cut, 75 feet south of the mill, which is about 45 feet deep, 25 feet wide and 30 feet long.

The plant consists of two boilers, one 50- and the other 60-horse power, a straight line compressor developing 300 cubic feet of air per minute, and two hoists.

A 10-stamp mill is in operation, driven by a 25-h.p. engine. The ore is crushed to about 30-mesh, amalgamated, and concentrated on two Wilfley tables.

Ore Chimney

The Ore Chimney Mining Company, capitalized for $600,000, own lots 34 to 36 in the first concession of the township of Barrie, Frontenac county. The officers of the company are as follows:—A. E. Fletcher, president, 220 Potomac Ave., Buffalo; Frank Misener, vice-president, Welland, Ont.; Chas. Narroway, secretary-treasurer, 335 Brisbane Building, Buffalo; Jas. Sullivan, mine manager, Northbrook, Ont.

There are three abandoned shallow test pits on various parts of the property, but work is at present carried on in what is known as shaft No. 4, which is sunk to a depth of 150 feet. At a depth of 125 feet a cross-cut has been run east 25 feet, and a drift run from this southwest 20 feet.

The plant consists of the following:—

1 100-h.p. Erie return tubular boiler;

1 Laidlaw-Dunn-Gordon compressor developing 600 cubic feet of air per minute;

4 machine drills;

1 No. 6 Cameron pump.

The company, at the date of inspection in April, 1913, were employing 12 men.

Iron Pyrites

Sulphide

Practically no new work was done during 1912 by the Nichols Chemical Company, the owners of the iron pyrites mine at Sulphide. The work has been confined chiefly to the north vein on the first and second levels, where stoping is being carried on. No. 2 shaft has been sunk to a depth of 575 feet. On this lower level 100 feet of drifting has been done on the south vein, and 200 feet on the north vein. The surface plant remains the same.

No change has been made in the acid plant, except the replacing of worn parts. The ore-crushing plant has been changed by the addition of a set of 16 by 36-inch rolls and a new dryer 40 feet in length by 5 feet in diameter. A No. 5 American blower fan. with a capacity of 2,040 cubic feet of air per minute, is being installed to take care of the dust formed at the crushing plant.

Mr. W. H. DuBlois is superintendent, employing 125 men.

Queensboro

The Canadian Sulphur Ore Company have been operating their iron pyrites mine continuously during the year. A branch line two and one-half miles in length from the Bay of Quinte Railway near Queensboro to the mine is under construction. A power line has been built from Madoc to the mine, and the plant is now run by electrical power purchased from the Seymour Power and Electric Company. The plant consists of a compressor with a capacity of 720 cubic feet of free air per minute driven by a 150-h.p. motor and single-drum hoists at Nos. 3 and 4 pits.

Work has been confined during the year to Nos. 3 and 4 workings. No. 3 shaft is 120 feet in depth, and at this level drifts have been run east 50 feet and west 50 feet. No. 3 open pit alongside of No. 3 shaft is 75 feet deep, 58 feet long and 25 feet wide. No. 4 open pit is west of No. 3, and is 60 feet deep, 25 feet long and 25 feet wide.

The mine is under the management of Mr. A. B. Willmott, who employs 44 men.

Talc

Henderson Mine

This mine, situated near the village of Madoc, is being operated under lease by Messrs. Cross and Wellington, who employ 22 workmen. Practically the whole output is sold as it comes from the mine to Geo. H. Gillespie and Company. All the machinery at the mine is operated by electric power purchased from the Seymour Power and Electric Company.

No. 1 shaft is 225 feet deep, with the first level at 120 feet. No work is being done on the first level. Drifts are being run on the ore on the second level. No. 2

shaft is 100 feet deep and at a depth of 100 feet a drift has been driven southwest on the ore to connect with No. 1 shaft. Some stoping was done along this drift but, owing to a fall of ground, has been discontinued.

Gillespie Mill

A mill for the grinding of talc in the town of Madoc alongside the Belleville-to-Madoc branch of the Grand Trunk Railway, is owned and operated by George H. Gillespie and Company. The crude talc is purchased from Messrs. Cross and Wellington, lessees of the Henderson talc mine.

The mill machinery is driven by electric power purchased from the Seymour Power and Electric Company.

Canadian Talc and Silica Company

This company operated their mine and mill for the production of talc throughout the year. The officers of the company are as follows: President, H. B. Hungerford, Chicago; vice-president and secretary, David Plant, Chicago; treasurer, M. H. Orde, Chicago; mine superintendent, Robt. M. Philips, Eldorado.

Two shafts have been sunk on the incline, No. 1 being 90 feet and No. 2 130 feet deep. On the 90-foot level of No. 1 shaft a drift has been run northeast 200 feet to connect with No. 2 shaft. The other work at this shaft consists of a stope 20 feet wide and 25 feet in height.

The mill is equipped with pulverizers for grinding the talc and bolting machines for grading it.

Connolly Mine

This mine adjoins the Henderson mine to the east, and is owned and operated by the Hungerford syndicate.

A shaft has been sunk a depth of 70 feet and drifts driven west 45 feet and northeast 25 feet. The plant consists of a 40-h.p. boiler and hoist.

Lead

Frontenac Mine

Work was carried on during the year by the North American Smelting Company at the old Frontenac lead mine in the township of Loughboro near Perth Road. No. 3 shaft has been sunk a depth of 150 feet, and a cross-cut 15 feet driven to the vein on this level. Drifts have been run on the vein northeast and southwest 200 feet respectively, and raises started at 20-foot intervals along the vein. The southwest drift is being run to connect with No. 2 shaft about 700 feet distant.

The plant at No. 3 shaft consists of one 90- and one 100-h.p. boiler, a Laidlaw-Dunn-Gordon compressor developing 625 cubic feet of air per minute, and a 10 by 8-inch jaw crusher and hoist. The company are also installing a double-drum electric hoist at this shaft.

The mill is located near No. 1 shaft, and the ore is hauled to the mill from No. 3 shaft by a Leschen aerial tram 4,000 feet in length. The ore is dumped into mill bins, then fed to 36-inch rolls and elevated to shaking screens, the coarse and medium product going to four Richards jigs, and the fines to a Richards classifier. The oversize from the screens goes to 24-inch rolls and back to the screens. The middlings from the jigs go to a Huntington mill and then to classifiers. The classified product is further treated on five Wilfey tables and three Frue vanners.

The power plant at the No. 1 shaft consists of a 100- and a 150-h.p. boiler, a 200-k.w. generator, a Bury compressor developing 800 cubic feet of air per minute and a 9 by 13-inch hoist. The machinery in the mill is all motor-driven.

Mr. W. M. Weigle, of Kingston, is manager both of the mine and the smelter at Kingston.

North American Smelter

The North American Smelting Company have built a lead smelter in Kingston for treating the ore from their mine, and also custom ore. A water-jacketed blast furnace has been erected with a capacity of 30 tons of charge per 24 hours, two open-hearth furnaces with a capacity of 10 tons each per 24 hours, one positive pressure blower with a capacity of 2,250 cubic feet of air per minute and one for regulating the draft. The blower fan and elevator are motor-driven, electric power being obtained from the city.

Buffalo and Ontario Smelter

The Buffalo and Ontario Smelting and Refining Company is a subsidiary company of the General Mines Company, the president being Geo. O. Wagner, Kingston, and the manager Geo. H. Fullerton of the same place. The smelting company was formed to treat the ores of the General Mines Company, also custom ores. The General Mines Company have acquired the Red Rock and Cobalt Contact mines at Cobalt.

The smelter is being equipped with the following:—

One positive pressure Connellsville blower, three 60-inch Buffalo exhausters, two reverberatory furnaces, one rotary furnace, two arsenic refining furnaces, one cupel furnace, two bag houses and dust chambers.

Power is supplied by a 75- and a 100-h.p. boiler.

Feldspar

Richardson Mine

The Kingston Feldspar and Mining Company continued operations and shipped steadily during the year 1912. Until the opening of navigation during the last week of April, both feldspar and quartz were teamed to Godfrey and shipped by rail in box cars. In the summer months the feldspar is loaded on flat cars at Glendower siding and transhipped to boats at Kingston.

The method of operating remains the same as described in former reports. A six-foot stope was taken up in the northwesterly end of the pit, otherwise the open cut was not extended.

Mr. H. W. Richardson, Kingston, is president and general manager of the Company. It is proposed to build an incline skip track and erect a concentrating plant. This will do away with hand sorting in the pit, and the output should be considerably increased.

The engine room and boiler house were destroyed by fire on August 21st, 1912, and shipping was suspended until repairs were made to the hoists.

Fifty men are employed under Foreman S. Hunter.

Reynolds Mine

This mine, owned and operated by the Kingston Feldspar and Mining Company on lot 1 in the thirteenth concession of Portland township, was worked till April 15th, 1912, and closed till September 1st. The pit was considerably extended at both the north and south ends, and several thousand tons of high grade feldspar produced. On account of there being no summer road to this pit, it is worked only in the winter months, the product being teamed to Verona on sleighs.

Card Mine

This mine, about two miles west of Verona Station, K. & P. Ry., is also owned by the Kingston Feldspar & Mining Company. During 1912 no work was done at the pit.

In April, 1912, about one thousand tons of quartz was loaded at Verona siding from the Card stock pile. The quartz capping at this mine has a very high silica content.

Mica

There was very little activity in the mining of mica during 1912: in fact the production of amber mica in Ontario is confined to a few of the properties that have been worked for years. No new properties of merit have been developed during recent years, although the price of mica has been steadily increasing.

Bob's Lake

Messrs. Stoness and Kent continued work at their mica property on the west side of Bob's lake during the year. As with mica-mining in general in the Province, no extensive underground work has been done, the mica being mined chiefly from surface pits. It is rough-cobbed at the mine and shipped to Kent Bros.' trimming works at Kingston.

Lacey

This mine, owned by the Loughboro Mining Company, still continues to be the main producer of mica in the Province.

As in 1911, all work during the summer months was confined to the open cut near the main shaft. During the winter, work was carried on from the main shaft at a depth of about 140 feet.

Mr. Geo. W. McNaughton is manager, employing 26 men.

Graphite

Black Donald

The Black Donald Graphite Company, whose mine and mill are situated about 12 miles from Calabogie in the county of Renfrew, were the main producers of graphite in the Province during the year. The mine is operated for about three months during the summer, and sufficient crude material is taken out to keep the mill supplied for the year. The pit is about 85 feet deep, and the graphite was stoped from the east end of the pit.

Mr. R. F. Bunting is manager and Mr. Geo. W. Stewart superintendent.

Virginia

The Virginia Graphite Company have built a concentrating plant and opened up a pit for the mining of graphite on lots 34 and 35 in the sixth concession of the township of Monmouth, near Wilberforce, on the Irondale and Bancroft railway.

The officers of the company are as follows:— President, J. J Tonkin, 86th Ave. and Broadway, New York; manager and secretary, H. G. Tonkin, Wilberforce; vice-president and treasurer, M. Du Pont, Atlantic City.

The open pit, formerly worked on the hill west of the mill, was abandoned at date of inspection, and two core drills were working to determine the ore body. This open pit was 75 feet in length, 40 feet wide and 37 feet deep. The company's property near Maynooth on the Central Ontario railway is being opened up, and the compressors formerly used at Wilberforce have been shipped here.

The ore is first dried and then crushed in two Taylor jaw crushers and two sets of rolls. It is taken from rolls on a conveyor belt to the dry concentrators.

New York Graphite Company

This company are developing a graphite property on lots 9, 10 and 11 in the twenty-second concession of Cardiff township, county of Haliburton.

The officers of the company are as follows:—

President, W. B. Spader, Cobourg, Ont.; secretary, J. G. Marshall, 135 William street, New York; manager, J. W. Brewer, Harcourt, Ont.

The mine and mill are situated just south of the Irondale and Bancroft railway, three-quarters of a mile west of Mumford station. The graphite has been found outcropping along the face of the hill and has been prospected by small open cuts. At the time of inspection, all work was confined to No. 3 open pit. This pit is equipped with a 40-h.p. boiler and hoist. Ore is hauled to the mill in three-ton cars.

A large mill has been constructed, but was not in operation in April, 1913. The scheme of concentration is to dry the ore and crush it first in a No. 4 Austin gyratory and then in rolls, and afterwards concentrate and grade it on Dallas dry tables and bolting machines.

The power plant consists of three 150-h.p. return tubular boilers, a 250-h.p. engine for driving mill machinery and an electric light plant.

Corundum

Manufacturers' Mine

The Manufacturers' Corundum Company operated under lease during 1912 the mines and mills both of the Canada Corundum Company and the Ashland Emery and Corundum Company. The large mill of the Canada Corundum Company at Craigmont was totally destroyed by fire early in 1913, which will probably affect the production of corundum in Ontario.

Mr. D. A. Brebner is managing director.

Silver Refinery

Deloro Mining and Reduction Company

The Deloro Mining and Reductions Company at Deloro continued the smelting of cobalt-silver ores throughout the year under the management of Mr. S. B. Wright.

The schedule of freight rates from Cobalt to Marmora station and the payment for the ores is given in the last report of the Bureau of Mines.

Blast Furnace

Standard Iron Company

Part of the plant of the Standard Iron Company at Deseronto was destroyed by fire during the year. It has been rebuilt and is again in operation under the management of Mr. R. H. Watson. The company are building another furnace at Parry Sound and expect to have it in operation in June, 1913.

Marble Quarries

Ontario

The Ontario Marble Quarries, Limited, are operating quarries for the production of marble on lots 28 to 30 in the tenth concession of Dungannon township about two miles south of Bancroft. About 32 men are employed under Superintendent Thos. Morrison. A siding is being constructed from the Central Ontario railway to the No. 1 and No. 2 quarries.

The plant at No. 1 quarry and sawing plant consists of the following:—

One 90-h.p. return tubular boiler, one 75-h.p. engine, one Fairbanks-Morse dynamo, one 20-ton steel derrick with hoist, one 10-ton hand derrick with winch, one Sullivan channeller, two drills, four gang saws for sawing the marble.

The plant at No. 2 quarry consists of:—

One 30-ton derrick with double-drum hoist, two 30-h.p. upright boilers, one Sullivan channeller, two steam drills.

At No. 3 quarry there is one 10-ton derrick.

Fluorspar

About two miles southwest of Madoc in the township of Huntingdon, Mr. C. Bowman has begun work on a deposit of fluorspar formerly worked by Messrs. Gillespie and Wellington. Camp buildings have been built and the old workings unwatered.

Limestone Quarries

Lehigh

The Canada Cement Company quarry limestone at Point Anne for use at their Lehigh and Belleville plants, and employ about 30 men in the quarry. A pit about 30 feet deep has been excavated over an area of six acres. A steam shovel is used for loading the broken rock into cars, which are trammed to the plant and the rock automatically dumped into crushers.

Point Anne

A limestone quarry was operated during the year at Point Anne, near the Lehigh plant of the Canada Cement Company, by the Point Anne Quarries, Limited, of which Mr. M. J. Haney is president, Mr. J. F. M. Stewart, manager, and Mr. A. G. Bennett, superintendent at Point Anne. The company ship crushed stone, rubble, crib-filling, etc., mainly by boat, their storage bins being on the lake shore.

Electric power is purchased from the Seymour Power and Electric Company. The crusher plant consists of a 175-h.p., 600-volt a.c. motor running three Gates' crushers, Nos. 4, 6 and 8. The crushed material from the crusher is screened and taken on a 36-inch conveyor belt 407 feet long to the bins on the lake shore. The rock is loaded at the quarry by a steam shovel into cars holding six cubic yards, and hauled by trolley to the crushing plant. The power plant consists of a compressor developing 700 cubic feet of air per minute, rope-driven by a 100-h.p. motor and a 225-h.p. motor-generator-set for furnishing power for the trolley line.

Britnell and Company

On parts of lots A and B in the sixth concession of the township of Somerville, near Burnt River, Britnell and Company, Limited, Toronto, are operating a limestone quarry, producing crushed and building stone. Mr. Wm. Britnell is manager, employing 35 men.

The plant consists of two 20-h.p. boilers and a 40-h.p. boiler, two hoists and three steam drills. The rock is crushed in a No. 3 Gates crusher, driven by a 35-h.p. engine.

Ontario Rock Company

At Preneveau, five miles east of Havelock, the Ontario Rock Company are operating a quarry for diabase. Nearly all their product is crushed and shipped to Toronto or the county of York for use in building roads, for which purpose it is well suited by reason of its toughness and great wearing qualities. A crushing plant and bins have been erected, and the crushed material loaded into cars on a spur built to the quarry from the main line of the Canadian Pacific railway.

Mr. A. Longwell, Toronto, is president and Mr. Geo. Rayner, superintendent.

Canada Lime Company

At Coboconk village in the county of Haliburton the Canada Lime Company are quarrying limestone for the manufacture of lime. Mr. C. R. Christie, 34 Yonge Street, Toronto, is president, and Jas. Ballantyne, Coboconk, superintendent. The company have three lime kilns, having a capacity of 26 tons per 24 hours. A derrick and hoist is used for dumping material into the kilns.

Toronto Brick Company

At Coboconk village the Toronto Brick Company are excavating limestone for use in the manufacture of lime. Mr. F. B. Allen, 64 Wellington Street, Toronto, is secretary, and Mr. C. M. Callam is superintendent, employing 11 men.

The broken rock is handled by means of a hoist and derrick and dumped into the kiln.

York Sand and Gravel Company

Near the Grand Trunk railway in East Toronto the York Sand and Gravel Company are excavating sand and gravel for use in the building industry. The sand pit is 25 feet deep, and standard gauge tracks are laid into the pit and the cars handled by a locomotive crane. The sand is excavated by a travelling derrick of 10-tons capacity.

Mr. C. S. Richards is superintendent, employing 20 workmen.

Excavations for Clay

Don Valley

At the Don Valley Brick Works, situated in the Don Valley, Toronto, and owned by Mr. Robt. Davies, both clay and shale are quarried for use in the manufacture of brick. The shale pit is circular, about 50 feet in depth and 200 feet in diameter. Two steam shovels, of 25 and 70 tons capacity respectively, are used in excavating the clay. The loaded cars are lowered by a gravity tram to the brick works.

Other Brick Works

The excavations of the following companies engaged in the manufacture of brick at Toronto have been inspected:

A. H. Wagstaff and Company, 362 Greenwood Avenue.
Bell Bros. Brick Company, 368 Greenwood Avenue.
Sun Brick Company, Don Valley.
John Price, Greenwood Avenue.
Prices, Limited, 500 Greenwood Avenue.
Standard Brick Company, 532 Greenwood Avenue.
J. Logan, Greenwood Avenue.

V.—SOUTHWESTERN ONTARIO

The industries in this area which come under the provisions of the Mining Act as regards inspection include silver smelting works, blast furnaces, gypsum mines, quarries, excavations in brickyards, sand and gravel pits, and lime kilns. A large number of these are worked in a very small way and at irregular intervals. The quarries are mainly of limestone for use in the manufacture of cement, as a flux for blast furnaces, in the making of lime, for building stone, and, when crushed, for road material and for use in concrete work.

Silver Refineries

Canada Refining and Smelting Company

The works of this company at Orillia were destroyed by fire the latter part of the year, and have not been rebuilt. They were engaged up to the time of the fire in treating silver ores from the Cobalt camp.

Coniagas Reduction Company

The Coniagas Reduction Company at Thorold treat all the ore from the Coniagas mine at Cobalt, and also custom ores from the Cobalt camp. Electric power is obtained from the Ontario Distributing Company. The machinery used in the plant is all motor-driven.

Ores are purchased on the following basis:—

Percentage of silver to be paid for on commercial assay of silver content per ton of 2,000 lbs. is as follows:

55	per cent.	for	50	ounces and	proportionate	increase in percentage up to
75	"	"	200	"	"	" "
78	"	"	300	"	"	" "
84	"	"	500	"	"	" "
91.5	"	"	1,000	"	"	" "
92.5	"	"	1,500	"	"	" "
93.5	"	"	2,000	"	"	" "
95	"	"	3,000	" and over.		

If sampled at purchaser's works at Thorold, sampling will be charged for at rate of $2.00 per ton of 2,000 lbs.

All ore purchased will be subject to a refining charge of 3/4 c. per ounce of silver contents.

Gypsum

Two companies are engaged in tbe mining of gypsum in the valley of the Grand river near Caledonia. Both companies have mills for grinding and calcining the product.

Alabastine Company

The company's mine is situated about three-eighths of a mile north of the town of Caledonia, on lot 10 in the first range west of the Hamilton and Port Dover road in the township of Seneca. The body of gypsum being mined occurs in a flat-lying bed about 80 feet below the surface. The gypsum is mined by the room and pillar system, the material being hoisted through an incline shaft. An area of about eight acres has been mined. The drilling is done by an electric rotary drill.

The gypsum is crushed and calcined in the mill situated about 75 feet from the mouth of the incline shaft.

Carson

The Alabastine Company also operate this property situated about three miles south of Caledonia. A good quality of white gypsum is mined here. A new air shaft has been put up 775 feet from the mouth of the incline shaft. The workings extend 200 feet beyond the air shaft. In this mine the worked-out places are filled by waste.

Crown Gypsum Company

The mine operated by this company is situated one-half mile from York on the south side of the Grand river in Oneida township, and the mill at Lythmore on the Michigan Central railway about three miles from the mine. The gypsum is hauled to the mill by a narrow-gauge railway operated by the company. The mine is worked from an incline shaft 720 feet in length. From the foot of this shaft, workings have been extended north and south 280 and 160 feet respectively. Mr. H. J. Brown is manager, employing 26 men in the mine and 11 in the mill.

Quarries

More carelessness is shown in the operation of their works by quarry owners than by mine operators. Some of the owners seem to think that, because they are working only a small crew, it is not necessary to look after the work as closely as if they were working a large gang. There is also less willingness on the part of owners of quarries to live up to the requirements of the Mining Act. Quarrying is not as dangerous a business as mining, and accidents should not be more numerous than in ordinary industrial enterprises where machinery is employed. The greatest degree of carelessness is shown in the handling and storage of explosives. The premature explosion of a few sticks of dynamite will kill a man as quickly as the explosion of a few tons. It is, therefore, necessary to use as great care in the storage, thawing and handling of explosives where only a few cases are used during the year as there is where a number of tons are used. The practice of thawing in the sun in the spring and autumn is largely in vogue in the smaller quarries. This is most dangerous. Another source of accident is the working of steep clay banks at brickyards. The practice of blasting at the bottom of clay banks to cave the whole bank above has proved to be dangerous, as the bank then remains nearly perpendicular and liable to cave at any time.

Canadian Quarries

At Stoney Creek, in the township of Saltfleet, the Canadian Quarries, Limited, are opening up a quarry for the production of crushed limestone. Mr. O. E. Quigley, of 26 Fairleigh Avenue, South Hamilton, is manager, employing 18 workmen.

A spur from the T. H. and B. railway, 3,566 feet in length, has been built to the quarry.

The plant consists of a No. 6 Austin gyratory crusher, screens, and a double-drum hoist for hauling cars of crushed rock from screens to loading platform. Two boilers of 25- and 40-h.p. capacity furnish steam for running machinery.

Clifton Sand, Gravel and Construction Company

This company are engaged in excavating sand and gravel in the township of Stamford.

The plant consists of three clam shells operated from A. frames by double-drum hoists, motor-driven. Electric power is purchased from the Ontario Power Company. About 10 acres are worked out to a depth of 60 feet.

Mr. J. J. Mackan, St. Catharines, is manager, and Mr. A. G. Bridge, superintendent, employing 18 men.

Doolittle and Wilcox

On lots 12 to 15 in the first concession of West Flamboro township near Dundas, Doolittle and Wilcox, Limited, are quarrying limestone, crushing it and selling it for use as a flux and for road material. Drilling in the quarry is all done by cyclone drills, motor-driven, which put down 4-inch holes to a depth of about 20 feet. The stone is loaded on cars in the quarry by a steam shovel. The loaded cars are hauled to the crushing plant by locomotives.

Electric power is purchased from the Cataract Power Company. The company have in use seventeen motors for driving the machinery in the crushing plant, drills, hoists, etc., using about 700 h.p. The crushing plant is equipped with a mammoth McCulla crusher having a rated capacity of 700 tons per hour, Nos. 6, 7½ and 8 Austin gyratory crushers and one set of 54-inch rolls. The plant is further equipped with trommels and conveyor belts for screening and distributing the crushed product.

Mr. J. D. Small is manager, employing 30 men in the quarry and 30 men at the crushing plant.

Empire Limestone Company

At Shisler's Point, on lots 4, 5 and 6 in the first concession of Humberstone, the Empire Limestone Company are quarrying limestone and excavating sand. Most of the material is shipped to Buffalo. An area of 16 acres has been worked over.

The plant consists of thirteen boilers having a total capacity of 775 horse power, a compressor developing 1,000 cubic feet of free air per minute, five "dinky" locomotives, a Vulcan and a Marion steam shovel, a sand clam and hoist for operating cars. In the crusher plant are two No. 7½ and one No. 9½ McCulla gyratory crushers.

Mr. T. R. Thomas is manager, employing 93 men.

Hagersville

On lot 14 in the thirteenth concession of Walpole township, Haldimand county, the Hagersville Contracting Company were engaged in operating a limestone quarry.

The plant consists of two 60-h.p. boilers, a 60- and a 150-h.p. gas engine and three crushers. Mr. D. C. Ingles is manager, employing 45 men.

Michigan Central

The Michigan Central railway operates a quarry of limestone at Hagersville. All material produced is used by the railway company for ballast and concrete work. An area of about eight acres has been worked out to a depth of 20 feet. The plant consists of two 75-h.p. and one 60-h.p. boilers, a compressor and drills.

Mr. D. C. Cronin is manager, employing 75 men.

Milton Pressed Brick Company

On lot 1 in the first concession of Esquesing near Milton, this company are excavating clay for use in making brick. About five acres have been worked out to a depth of 40 feet. The clay is loaded in cars and trammed out of the pit with horses.

Mr. J. S. McCannell is manager, employing 40 men in the clay pit.

Toronto Pressed Brick Company

Near Milton, in the township of Esquesing, this company are excavating clay for use in making brick. About 18 men are employed under Superintendent C. B. Lewis.

Queenston

On lots 47 and 48 in the third and fourth concessions of Niagara township, county of Lincoln, the Queenston Quarry Company are excavating limestone for use as building material and also crushed for road material and concrete work. The equipment consists of four Beatty double-drum hoists with derricks, a Belleville hoist and an A. frame sand clam-shell derrick with Beatty hoist. These hoists are all steam-operated with six small upright boilers. A 350-cubic foot compressor, motor-driven, supplies air from the drill. The crushing plant is equipped with a No. 5 Austin crusher and a Simons disc crusher, both motor-driven with 40-h.p. motors.

About 60 men are employed under Manager Chas. Lowrey.

Wentworth

On lot 4 in the fifth concession of the township of Saltfleet, the Wentworth Quarry Company are quarrying limestone and crushing it. Mr. F. W. Schwendiman, Vinemount, is manager, employing 25 men.

Power for the crushing plant is supplied by a 120-h.p. Dudbridge gas engine which runs the crushers and screens. The rock is hauled up an incline standard gauge track and dumped direct into a No. 7½ McCulla crusher, rated at 75 to 100 tons per hour. From this crusher the product passes over a trommel, and the oversize to a No. 5 McCulla and then to rolls. Five products are produced: rock sand, ¼-inch, ½-inch, 1-inch and 2-inch rock.

Drilling is done with a cyclone drill, making a 4½-inch hole, and working a 15-foot face. A steam shovel is used for loading the broken rock into cars in the pit.

THE WHISKEY LAKE AREA

By A. P. Coleman

Introduction

Though the Whiskey lake area has been known for some years to contain more or less copper ore,[1] etc., little attention has recently been paid to it by prospectors or geologists until the discovery of gold on the east shore of Whiskey lake early in 1912. Following the instructions of Mr. T. W. Gibson, Deputy Minister of Mines for Ontario, the present writer visited the region during the summer of 1912 examining the mining locations and mapping the geology as far as could be done in the vicinity of the lakes. No map covering the geology of the area has yet been published, though topographic map sheet No. 129, prepared by the Geological Survey of Canada some years ago, includes this district. The sheet was never issued, and I am under great obligations to the Director of the Survey for permission to use a copy in my field work. It proved of much service, though its small scale (4 miles to the inch) and the fact that some of the lakes on which work has been done are not shown on it have made it necessary to re-map most of the topography.

Sable river, Massey.

During my work in the area, Mr. Charles Baycroft proved a very efficient assistant. Messrs. George and John Wallace, firerangers on the lakes, were very helpful and hospitable, and their intimate knowledge of the region was of much value.

Whiskey lake and the neighboring bodies of water are in the third and fourth tiers of townships of Algoma north of lake Huron. As they have not yet been subdivided for settlement they are unnamed, but may be referred to as Nos. 137 and 138. These townships have merely been blocked out and there are few lines available for fixing points in the topography, but a number of mining locations surveyed in the region have been of service in this respect.

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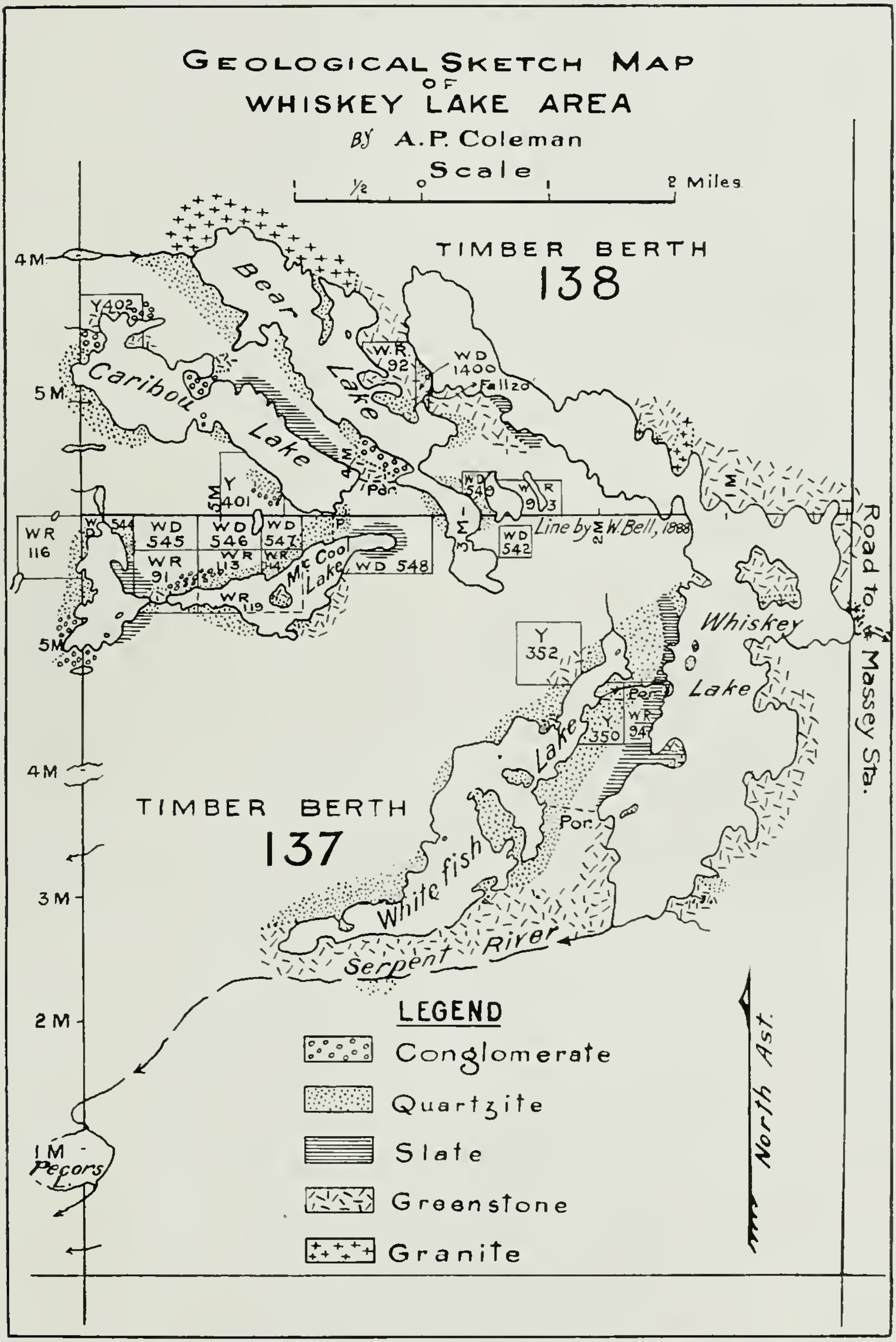
[1] Bur. Mines, 1906, Vol. XIV., pp. 62-67; and Vol. XV., pp. 69-70.


GEOLOGICAL SKETCH MAP
OF
WHISKEY LAKE AREA
BY A.P. Coleman
Scale
½
0
1
2 Miles
TIMBER BERTH
138
TIMBER BERTH
137
Bear Lake
Caribou Lake
McCool Lake
Whiskey Lake
Whitefish Lake
Serpent River
Pecors L.
Y402
W.R. 92
WD 1400
Fall 20
Y 401
Por.
P
WR 116
WD
544
WD 545
WD 546
WD 547
WR 91
WR 113
WR 114
WR 119
WD 548
WD 549
WR 913
WD 542
Line by W. Bell, 1888
Y 352
Por.
Y 350
WR 947
Por.
4M
5M
5M
4M
3M
2M
1M
4M
3M
2M
1M
Road to Massey Sta.
North Ast.
LEGEND
Conglomerate
Quartzite
Slate
Greenstone
Granite

Whiskey lake is best reached by a lumber road running about 30 miles northwest of Massey on the Sault branch of the Canadian Pacific railway; but it may also be reached by canoe from Serpent, 25 miles farther west, since Serpent river is the outlet of Whiskey lake. During the earlier part of the summer this route is apt to be blocked with log drives.

Though the road from Massey follows roughly the valley of Sable river, it crosses the divide westwards near Whiskey lake, and the drainage of the whole system of lakes is southwest by Serpent river. The numerous falls and rapids between lakes or on the course of the river are overcome for lumbering purposes by dams and slides. Whiskey lake, the largest of the group of lakes, is about seven miles long and one mile wide. The lakes named Whitefish, Bear and Caribou are not more than half this size. It is a pity that these names should be repeated so often.

The general topography of the area is that characteristic of the Archæan, consisting of rocky hills rising above lakes of irregular shape, with occasional flats of swamp land or old lake deposits. The mean of two aneroid readings (taken in changeable weather) puts Whiskey lake 364 feet above Massey, or 1,000 feet above the sea; and the other lakes range from 21 to 130 feet higher. On the southwest shore of Caribou lake a hill rises about 700 feet above the water, or about 1,800 feet above the sea, forming the culminating point of the region; and a number of other hills rise 300 or 400 feet above the general level, giving an unusually high relief to the country.

There is comparatively little good soil in the area, except along Serpent river southwest of Whiskey lake, where some hundreds of acres of excellent sandy loam are covered with hardwood forest. The district has largely escaped burning, and on sandy tracts and on morainic and rocky hills there is often a good stand of red or white pine. This has been more carefully preserved than the pine in most of northern Ontario, and represents a considerable reserve of good timber. Lumbering is active in the district to the north on the head waters of Serpent river; and several "alligators" as well as large gangs of men were engaged in taking down drives of logs in the early summer of 1912.

General Geology

The solid rocks observed in the area include granite and syenite, greenstone and green schist, quartzite often associated with conglomerate or tillite, limestone and slate. Of these rocks the greenstones and green schists cover most space, especially toward the east and southeast; quartzite comes next, followed by slate, conglomerate and limestone, the last rock occurring only in outcrops too small to be mapped on the scale employed. The map has been prepared almost entirely from work done by canoe, so that little of the inland portions has been touched beyond the outcrops on portages and in the vicinity of mine workings.

As to classification, it is probable that part at least of the greenstone and green schist is Keewatin, that the granite and syenite are Laurentian, and that the other rocks belong mainly to the Huronian; though there is reason to think that some of the sedimentary rocks are earlier than the Huronian, probably of the age of the Sudbury series, which comes between the Huronian and Keewatin. The quartzite often passes into coarse conglomerate with the character of tillite, and there must be two ages of quartzite, since pebbles of quartzite are found in the conglomerate. It is probable that there are conglomerates of two ages also, a boulder of conglomerate occurring in the tillite at one place. The slate appears to be the lowest and oldest sedimentary rock of the region, and is sometimes cut by greenstone.

From the relations mentioned above one may conclude that the two conglomerates are at the base of the middle and lower Huronian respectively, and that much of the quartzite will go with them into the Huronian. It is probable, too, that the limestone and at least one bed of slate must be considered Huronian; while the rest of the slate and part of the quartzite are pre-Huronian and probably of the age of the Sudbury series.

The rocks of the region probably include therefore:

Middle Huronian—conglomerate and quartzite.
  Unconformity.
Lower Huronian—conglomerate, quartzite, slate and limestone.
  Great unconformity.
Sudbury series—slate and probably quartzite, part of the greenstone.
  Unconformity.
Keewatin—most of the greenstone and green schist.
  Eruptive contact.
Laurentian—granite and syenite.

While probably all of these subdivisions are present, some of them are very difficult to separate without more field work than could be devoted to the area; and on the map a lithological classification is adopted, all quartzites being represented by the same symbol, and conglomerates likewise.

Greenstone, trunk road west of Massey.

Detailed Geology

Road to Whiskey Lake

The road from Massey, which begins on a sand terrace at 639 feet, ascends two other sand terraces at 710 and 870 feet within the first ten miles, evidently water levels of ancient lake Algonquin. The sand plains are largely delta deposits formed by the Sable (Sand) river when it entered lake Algonquin at the above levels. The Sable is now cutting down its channel to bed rock through these stratified sand deposits. As long as the road follows the drift-filled valley of the Sable outcrops of bed rock are rare, and consist mainly of knobs of granite.

Approaching Twelve-mile creek, greenstone occurs frequently with the granite, and between this and Cameron creek boulder clay covers much of the surface, though greenstone penetrated by granite is frequently seen. About two miles south of Twenty-mile creek (really 18 miles from Massey) the road ascends a high and wide ridge of greenstone running northeast and southwest. This has a width, as crossed by the road, of nearly half a mile. Farther to the north there is a mixture of the two rocks once more, but this ends a little beyond Twenty-mile. The ten miles completing the distance to

Whiskey lake show mainly green schist with a northwesterly strike. A few dikes of red granite cut the schist in places. During the last half mile sand and drift deposits hide the bed rock until an eastern bay of Whiskey lake is reached.

Whiskey Lake

The main body of Whiskey lake runs three miles a little west of south from the bay at which the lumber road ends, and a large hilly island hides an arm which extends 4½ miles northwest. The eastern shore and southern end, where not formed of drift, consist mainly of different phases of greenstone, including hornblende, porphyrite, green schist, and in some places agglomerate. Rarely a trace of pillow structure may be seen. The whole were no doubt the basic lavas so commonly found in the Keewatin.

Through the greenstones a band of red granite rises north of the end of the road and crosses the southern end of the large island. The north shore of the western arm, where not drift-covered, includes both greenstone and red granite, as may be seen from a lumber road which runs along that side of the lake and continues westward along Bear lake, the next in order.

Whiskey lake, showing pine trees.

The most interesting rocks on the lake lie along the west coast of its southern part or on islands, and include the best-known gold deposits. The promontory separating the two parts of the lake is of morainic materials, below which a little greenstone may be seen on the shore. Going southwards one encounters quartzite with a north and south strike and a dip of 25° to the west. The rock is cross-bedded and contains pyrite. Parts of it include angular or rounded pebbles of quartz, felsite and greenstone; and opposite an island the rock may be described as a conglomerate of pebbles and boulders of granite, felsite, greenstone and schist, with a coarse matrix of arkose. The strike here is 160° and the dip hard to determine. The shore is largely drift-covered, making the relations uncertain, but the conglomerate is apparently lower Huronian, and a small point of rock between it and the quartzite consists of gray-green schist penetrated by pegmatite, suggesting a basal complex. To the south of the conglomerate slate appears with a nearly north and south strike and a dip of 10° or 15° to the west, the cleavage crossing the stratification at a small angle.

A small island near by consists of conglomerate once more, with angular or subangular pebbles and boulders, like those referred to before, but including many of slate, enclosed in coarse arkose. The conglomerate is in one place parted by a slaty layer. The largest boulder seen is of granite and measures 3 x 2½ feet. Inland a hill of slate rises 200 feet, while to the west another hill reaching 240 feet is capped with conglomerate. Quartzite with a gentle dip to the northwest shows on the shore to the south. The rocks just described are on WR 94, the claim including the gold deposits.

On a small point projecting at the south of the location patches of greenstone cut slate like that referred to above, and the shore for half a mile to the south consists mainly of slate with a cliff of the same rock inland. The last half mile of shore, reaching to the outlet of Serpent river, shows only greenstone.

There is evidently a complicated series of rocks, including at least three ages, the slate and probably most of the quartzite being oldest, since greenstone comes up through them, and the conglomerate latest. The slate and most of the quartzite appear to be earlier than lower Huronian, and therefore may belong to the Sudbury series; and the greenstones seem to be later than the Keewatin.

The quartzites and slates have been greatly shattered and faulted in places, and the fissures are filled with quartz charged with sulphides and some free gold.

Looking north from the falls at outlet of Bear lake.

Whitefish Lake

From near the north end of WR 94 a portage leads westwards for half a mile to Whitefish lake, with a rise of 77 feet, crossing drift and quartzite boulders most of the way, though quartzite rises in place at one point to the north of the stream as a cliff overlying a few feet of slate. Except along the southern side of the lake, where greenstone forms the shore, quartzite is commonly found, sometimes with pebbles or boulders of granite or slate enclosed, showing that these rocks existed before the quartzite. Near the southwest end of the lake a cliff consists of slate, rising 50 feet, with a strike of 60° and a northwesterly dip, followed by quartzite to the top, which is at about 100 feet above the lake.

A portage 240 paces long leads southward from Whitefish lake to Serpent river, crossing greenstone at first and then a ridge of moraine. The river is 85 feet lower by aneroid.

Toward the north end of the lake, on location Y 352, a steep hill of greenstone rises through the quartzite, and probably some ore has been found in connection with it, though we saw no workings.

The age of the quartzite which forms so much of the coast is probably Huronian, since in places it becomes conglomeratic and encloses rounded fragments of slate, probably from the Sudbury series, but possibly lower Huronian.

Bear Lake

The northwest arm of Whiskey lake is mainly enclosed in shores of drift, but its southwestern bay leading towards the outlet of Bear lake is of rock, chiefly greenstone rising as hills, but including patches of quartzite and slate. The most interesting outcrop is at the Reynolds mine, between Whiskey and Bear lakes, where copper ores occur at the contact between greenstone and the sedimentary rocks. On a hillside northeast of the mine, sloping toward Whiskey lake, one finds a section of 100 feet, consisting of 45 feet of impure limestone on top, followed by 20 feet of slate and probably 50 feet of conglomerate at the foot of the cliff. A little farther toward the shore quartzite appears to dip under the conglomerate. The series dips 15° to 20° to the southwest, and the outcrop is surrounded by greenstone and green schist except on the side toward Whiskey lake.

The portage follows Serpent river, draining Bear lake, with a rise of 21 feet toward the upper lake, and passes over greenstone, which rises as cliffs on each side. This belt of greenstone extends for an unknown distance southeastward and as a ridge for half a mile westward to a bay of Bear lake. A point just west of the upper end of the portage consists of thickly-bedded quartzite with a dip of 45° southwestward. Coasting northwestwards one encounters the rugged ridge of greenstone just mentioned followed by a bay on whose north shore greenstone and granite are found.

A long narrow peninsula stretching south from the western side of the bay is of quartzite. The shore beyond this toward the west is of red granite, which continues as striking cliffs for at least a quarter of a mile along the north bank of Serpent river, which enters at the head of the lake. On the south side there are cliffs of quartzite, which extends southeast to the bay leading toward Caribou lake, with a dip of 20° to the south or southwest. This is followed by conglomerate with boulders of granite, slate and other rocks, probably resting on the quartzite. A hill west of the portage shows 200 or 300 feet of slaty rock, with some greenstone on top. On the portage there are large boulders of fine-grained white limestone or marble, much purer than that mentioned near the mine. The shores of the lake toward the southeast, where not drift-covered, consist of quartzite or slate apparently penetrated in one or two places by greenstone.

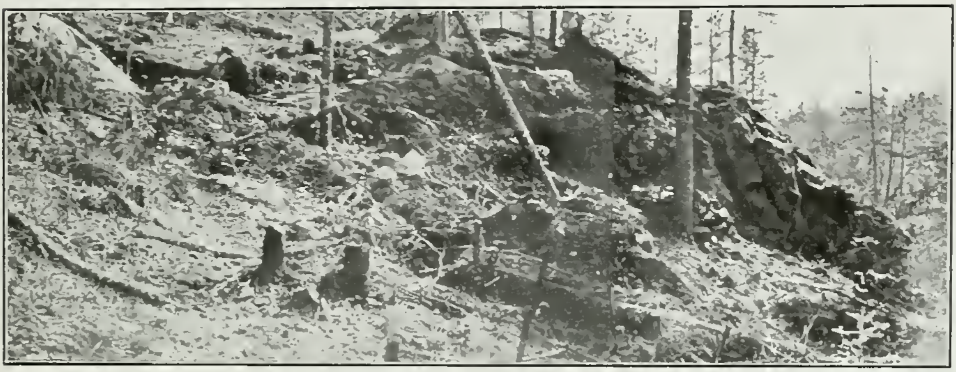
Caribou Lake

Two portages lead from Bear to Caribou lake, which is less than two miles long, but has very varied shores, rising to hills 700 feet high and presenting cliffs of at least 100 feet. The rocks represented include quartzite, slate, conglomerate, limestone and greenstone. The top of the highest hill, south of the southeast end of the lake, consists of conglomerate; and a cliff to the north on the opposite shore shows limestone with some slate forming a gentle anticline. Limestone collected on an island is compact, bluish-gray and shows conchoidal fracture. As it weathers rusty it must contain an appreciable amount of siderite. The greenstone contains copper ore in a few places, giving the occasion for the locations which were taken up on the lake.

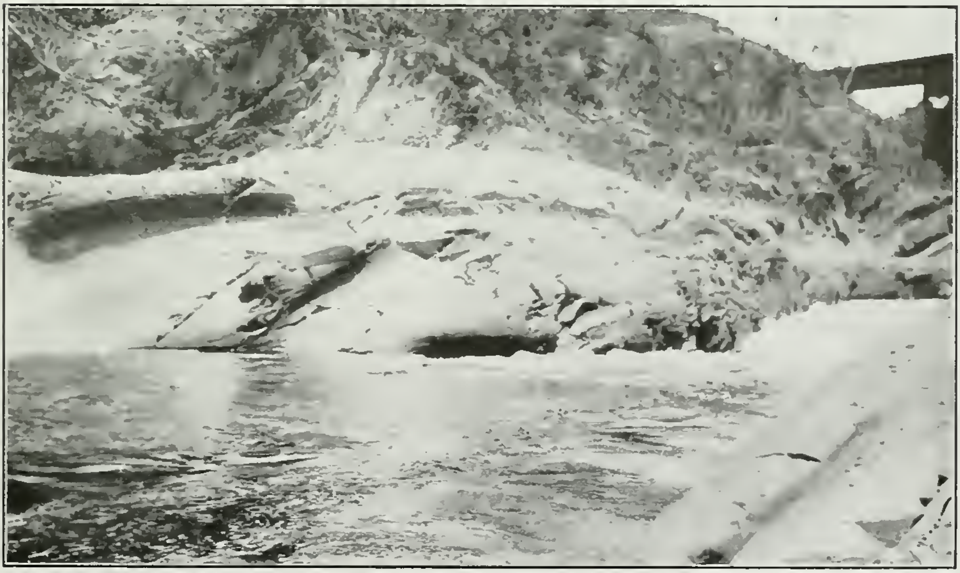
McCool and Corner Lakes

From the southeast end of Caribou lake a short portage leads south into McCool lake, which has a length of two miles from east to west and gives access from its west end to Corner lake, the last of the chain. The rocks which have been referred to on the other lakes are repeated here with the exception of limestone and with the addition of fine grained reddish-gray arkose. Quartzite with the usual gentle southwesterly dip forms most of the northern side of McCool lake, with a mixture of slate, conglomerate and greenstone in other parts. The large island in the centre consists mainly of rugged greenstone.

The shores of Corner lake consist of the same rocks less regularly distributed. The locations on both lakes seem to have been taken up on quartz veins.



Ore outcropping on Reynolds property, as seen from blacksmith shop. Shaft is situated around the point on right.



Ice carving, Sable river.

Ore Deposits of the Region

More than a score of claims have been located on the group of lakes just described, and some of the lines were evidently freshly cut in the early summer of 1912. The earlier locations were taken up for copper[2] and the later ones for gold. Both metals occur and small amounts of cobalt ore have been found also. The property which has recently attracted most attention is the Payton, or as it is often called, Wilson's mine. This property on the west shore of southern Whiskey lake has been located for a number of years, and appears to have been taken up first for copper. About fifteen years ago a small shaft was sunk close to the shore by Mr. Teasdale, on a little deposit of copper pyrites in quartzite. The rock is distinctly bedded, with finer and coarser parts and some greenish-slaty seams, and has been more or less shattered and faulted. Five years ago a pit was sunk 20 paces inland, on a fault plane or shearzone, where a little smaltite and cobalt bloom may still be found on the dump.

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[2] Bur. Mines, XIV., Part I., pp. 64-67, and XV., pp. 69-70. Reports by W. E. H. Carter, then Mines Inspector.

The recent work carried on under the management of Mr. Art. Teasdale has been much more extensive, including a large amount of stripping and trenching, with a few quite large test pits. The ore as disclosd is rusty quartz containing, where not too much weathered, pyrite, pyrrhotite and a little copper pyrites and galena. Free gold could be seen at a number of places, and in general the ore looked promising in June, 1912; but the final test of its value was still to be made.

The workings included several hundred feet of stripping and disclosed quartz veins 2½ feet wide and less regular bodies of quartz of much larger size. Most of the ore occurred in slate, but some in quartzite.

The only other ore deposit on Whiskey lake that seemed to have importance is what is called Reynolds' mine, at the northwest end of the lake, on a hilly ridge between it and Bear lake. This is a deposit of green schist with copper pyrites near the contact of greenstone, with sedimentary rocks, including impure limestone. The ore contains much quartz and is widely diffused but with indefinite boundaries. The zone, including some infiltrated ore can be traced, it is said, for 1,000 feet with a southwesterly strike, but comparatively little of the ore seemed high enough in grade to work. It is stated that at one point a width of 30 feet of ore assayed five per cent. of copper. A shaft 50 feet deep ends in schist, the ore body, which is very irregular, dipping away from it.

Work was done on this property by Mr. Charles Baycroft for Major R. G. Leckie, but this ceased in October, 1910, and will probably not be resumed before a railway outlet is provided.

On the southwest side of Caribou lake, near its southeastern end, rich copper ores have been found in boulders of morainic origin, and some work has been done in the way of stripping with the aim of tracing up the ore-bearing blocks to their source in the bed rock. The boulders are of quartzite, and in one case a shaft sunk 25 feet disclosed quartzite also, but much poorer in ore. A little cobalt bloom occurs on the quartzite of the dump. High on a hill side some hundreds of yards to the southeast of the small shaft more quartzite boulders with very rich ore have been found as parts of the boulder clay.

Toward the west end of McCool lake, on the north side, a long quartz vein has been exposed by stripping extending several hundred feet. The quartz is sometimes five feet wide and is often rusty through the weathering of pyrite. Occasionally, specimens are rich in copper pyrites, but no gold was seen. This vein has a strike of 70° and runs between quartzite on the north and slate or greenstone toward the south. A little tillite shows beyond the strip of quartzite on a ridge to the north.

In general, one may say of the region that promising-looking quartz occurs at a number of places, but that free gold was seen only on the Wilson properties on Whiskey lake. Copper pyrites occurs at numerous places, and may be present in large enough quantity near the portage from Whiskey to Bear lakes to be of importance if railway communication is provided in the future. Small traces of cobalt minerals are found in quartzite on Whiskey and Caribou lakes, but no silver has been observed, so that they are probably of no importance.

It may be that an island of limestone on Caribou lake may some day be of value in a region so devoid of limestone in general, but this, of course, would require railway connections, of which there is at present little prospect.

THE MASSEY COPPER MINE AREA

By A. P. Coleman

Introduction

Copper ores have been found in many parts of northern Ontario, partly in association with nickel, and partly as independent deposits; but at present the only copper mined in the Province comes from the nickel-copper deposits of Sudbury, in which nickel is the more important metal. Of mines opened for copper alone within recent years the Massey and Hermina mines in Salter township are those on which most work has been done. In accordance with the instructions of Mr. T. W. Gibson, Deputy Minister of Mines for Ontario, the geology of the area, including these two mines, was studied by the present writer during the summer of 1912.

The Massey mine, or Massey Station mine, has been known for about thirteen years, and the history of its development may be found in several reports of the Bureau of Mines from 1901 to 1907.[1]

As stated by the Inspector of Mines, Mr. C. De Kalb, in 1900, the copper-bearing deposits were first traced on the surface by test pits for a mile east and west a little south of the contact of granite with green schist, and a shaft was sunk 80 feet on the main deposit. In later years the shaft was deepened to 550 feet and on seven levels more or less stoping was carried on, furnishing some thousands of tons of ore. Part of this was shipped to Copper Cliff and to Victoria Mines for use in connection with the smelting of the nickel ores, but apparently was not entirely suitable as a fluxing mixture. A plant was then erected in 1904 for treating the ore by the Elmore oil concentrating process, but this proved unsuccessful, and in 1907 the mine was closed down.

The Hermina mine was opened in 1903, and a shaft was sunk to a depth of 500 feet. In 1908 a smelter was constructed at Thessalon, partly to treat the Hermina ores and partly for custom work, but both mine and smelter have been closed down for some years. Both the Massey and the Hermina mines are connected by short railways with the Sault branch of the Canadian Pacific, the Massey mine branch ending at the station of the same name three miles southeast, and the Hermina branch, 4½ miles long, ending a little east of Walford, the next station beyond Massey.

Topography

The township of Salter, which includes the Massey and Hermina mines, extends northwards from Spanish river, here at the level of Georgian bay, which it enters a few miles to the west. The southern third of the township shows mainly old lake and river deposits, partly swampy and partly sandy, but largely consisting of good farming land rising not more than from 20 to 100 feet above lake Huron. The flat farm land along the river side, with an elevation of 620 to 640 feet above sea level, probably corresponds to one of the old Nipissing beaches; but to the north there are two terraces reaching elevations of 710 and 870 feet, which belong to lake Algonquin. Along the valley of Sable river, which comes into Spanish river from the north at the village of Massey, these terraces are of sand, deposited as delta materials by the river itself at the various old lake levels; and the valley of the Sable shows good sections through the sandy lake deposits. Farther to the west the flat alluvial deposits are loamy or clayey in character. The comparatively low plain of sand and clay is often very level along the north shore of lake Huron, and above it rise steep hills of the harder rocks, generally as ridges with the usual trend of the rock structures of the region, about north 70° east. These hills are often isolated and rise island-like above the farm lands to heights sometimes reaching 200 feet or more. The highest hills are generally of

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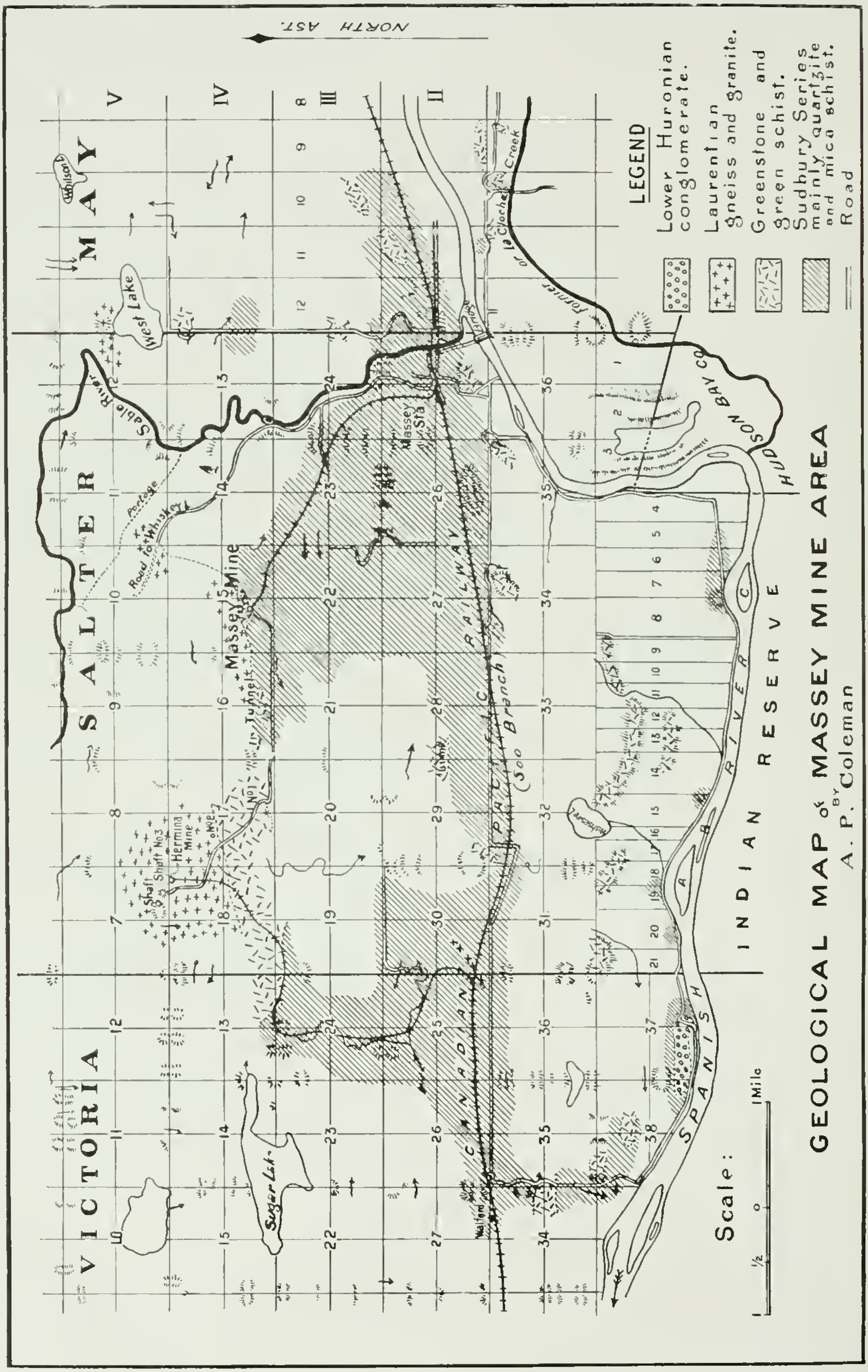
[1] Bur. Mines, Ont., Vol. X., p. 120; Vol. XI., p. 81; Vol. XII., pp. 97-8; Vol. XIII., p. 78; Vol. XIV., p. 61; Vol. XV., p. 67; and Vol. XVI., p. 68.



GEOLOGICAL MAP of MASSEY MINE AREA

BY A. P. Coleman

some variety of greenstone, though quartzite also forms hills, and toward the north of the township there are the usual rounded granite hills of a Laurentian country.

A large part of the township along the Spanish river and the Sable is of alluvial deposits, so that it is not possible to trace geological boundaries for any great distance continuously; but there are many and excellent outcrops of rock in the hills and also along the bed of Sable river.

No detailed map of the geology of the region has been published, though the topography was worked out more or less completely by land surveyors and by Dr. Bell and his assistants, and was represented on the Missasaga topographic sheet, No. 129, of which the Geological Survey was good enough to furnish a proof. It shows no details in Salter township which are not found on the original township map prepared by Chas. Unwin in 1861, with the addition of the "broken front" prepared by T. O. Bolger in 1884.

Since the railway from Hermina mine to Walford extends into Victoria township west of Salter, the eastern part of that township has been examined also. In general character it corresponds to the description given above. Most of the arable land in both townships is now occupied by prosperous-looking farms.

The whole of the area described is drained by Spanish river and its tributary Sable river, which with their bends enclose most of Salter township on three sides. There are fewer small lakes than in most parts of northern Ontario, probably because the widespread deposits of the great ancient lakes mentioned above filled up most of the original basins.

General Geology

So large a proportion of Salter township and of the townships of Victoria to the west and May to the east is covered with old lake deposits that the relations of the solid rock formations are not always clear. In many cases there are isolated hills of a single kind of rock separated by drift from the next hill, which may be of a different kind. In general, the solid rocks may be divided into sedimentary varieties and eruptives, the latter often penetrating the former. The sedimentary rocks undoubtedly belong to two distinct ages, since one group of them contains pebbles of the others.

Most of the sedimentary rocks are older than the greenstones and granites which penetrate them, and the granites are of the type generally classed as Laurentian. They are, therefore, apparently Pre-Laurentian. The later group of sediments, which covers only a small area, includes granite pebbles and boulders and is clearly Post-Laurentian. The Pre-Laurentian rocks must belong either to the Sudbury series or the Keewatin, and their general relationships correspond best to those of the Sudbury series.

The most natural classification is the following:

Pleistocene	Old lake deposits of sand and clay.
	Glacial deposits of boulder clay.
	Great interval.
Archæan	Lower Huronian—conglomerate and quartzite.
	Unconformity.
	Laurentian—granite and gneiss.
	Greenstones.
	Sudbury series—quartzite, phyllites, mica schist, etc.

Beginning with the oldest rocks, the Sudbury series consists of a band of sedimentary deposits running east and west through the townships with a width of four miles, in several places, however, more or less broken by ridges of greenstone, which have pushed up through them. As the beds are always steeply tilted, from 60° to the vertical, the thickness is great, certainly thousands of feet; but the strike and dip vary a good deal from place to place, and there has probably been folding and faulting, so that the real thickness may be much less than four miles, perhaps not more than one. The rocks here classed as belonging to the Sudbury series differ considerably from the typical Sudbury series as shown 50 miles to the east, mainly in being more metamorphosed. Instead of quartzite showing its original bedding and cross-bedding, the rocks near Massey are usually quartz schists or mica schists with a good deal of mica, though there are some less changed quartzites. The schistose varieties are often coarse-textured with large flakes of muscovite which glitter in the sun. In places they contain the usual minerals of contact metamorphism, such as staurolite and garnet, features which cannot always be directly explained by the presence of outcrops of eruptive rocks in the neighborhood. Beside the more quartzose sediments there are smaller amounts of slate passing into phyllite and mica schist. Slate may be interbedded with quartzite; and in some places green chloritic schists are interbanded with mica schist.

The hills and ridges of greenstone which rise above the plain are at least in some cases younger than the Sudbury series, since they have heaved them up in a laccolithic way. It may be that some of the green schists are older and belong to the Keewatin, though this has not yet been proved.

The greenstones are often so changed into chloritic and hornblendic minerals that their original composition is uncertain, but anorthosite, hornblende, porphyrite, and diabase can sometimes be distinguished. The greenstones pass into green schists in places.

The granites and graintoid gneisses are pink in color and range from ordinary medium-grained rock to pegmatite. They make up a large part of the northern side of the townships and may be looked on as Laurentian. They are distinctly younger than the quartzite and also than the greenstone, both of which are penetrated by granite dikes and are carried off as fragments by the granite. In only one case has granite been found within the broad band of rocks of the Sudbury series, near mile 16 on the Sault railway crossing the boundary of Salter and Victoria townships. Here it forms a dike which can be traced for half a mile through quartzite, which it has penetrated and lifted up. The dike is 20 or 30 paces wide and is itself cut by irregular masses of pegmatite.

The copper ores of the Massey and Hermina mines are either in granite or not far from it, and may have been introduced by magmatic waters from the eruptive.

The Lower Huronian is confined so far as known to the north shore of Spanish river near the boundary of Salter and Victoria townships. A belt of quartzite or arkose containing scattered pebbles and boulders of granite and quartzite here runs for half a mile east and west, forming a prominent ridge. It is in places 900 feet wide with a band of quartzite to the north and flat fields of old lake deposits to the south. No stratification has been observed, and the outcrop is probably a somewhat thin flat sheet of tillite. Its matrix is much like that of the Lower Huronian north of Ramsay lake at Sudbury, but it is far less crowded with boulders.

It may be that a fine-grained arkose found a mile and a half northwest, to the east of the road from Walford, is of the same age. It contains no mica, and differs in appearance from the ordinary quartzite.

The Pleistocene of the Massey region consists of boulder clay in valleys between the rock hills toward the north above the old lake levels, and of stratified sand and clay below these levels toward the south. The sand extends for some distance on each side of Sable river, forming barren plains; but outside of this belt clay predominates. It is pale gray and well stratified and makes fair farm land. It burns to a pale red brick at a point a mile or two northeast of Massey, but some parts of it are calcareous enough to contain lime concretions.

The Massey Copper Mine

A railway three miles long connects Massey on the Sault branch with the Massey mine, running first north and then bending toward the northwest, the workings of the mine being in the southwestern quarter of section No. 15. The railway runs over old lake deposits except for half a mile of mica schist, where the line bends northwest. Beyond this no solid rock shows itself until the mine itself is reached, where a low mound rises above the drift for 180 yards, consisting of quartzite toward the southeast and green schist to the northwest, both more or less brecciated and crossed by quartz veins. The bedding of the quartzite has a strike of 60° east of north. The rock dump consists mainly of green schist with a good deal of reddish-gray quartzite and some massive vein quartz. A hundred yards to the east there is another patch of quartzite and crush conglomerate, but otherwise the surface in all directions is drift-covered. Say 200 or 300 yards northwest at the outlet of a pond which was dammed for a water supply, a glaciated surface of greenstone shows itself; and a quarter of a mile through the woods to the northeast there is green schist with a little slate and quartzite on the flanks of a hill whose top consists of red granite. The greenstone and granite are the nearest eruptive rocks to be seen, but the covering of drift may hide granite or greenstone in the immediate vicinity of the mine.

There is little ore on the dump, chalcopyrite being the only visible copper-bearing mineral, and it seems to be associated with the green schist rather than the quartzite.

The rockhouse is connected by tramway with the concentrating plant a short distance to the west, but at the time of my visit the caretaker was away, and the buildings were locked up.

Reports of the Mine Inspectors during the years when the mine was in operation, as mentioned on a former page, give brief accounts of the results of mining. The ore was reported to run from 3½ to 6 per cent. of copper with traces of gold in 1901, when the mine was first opened;[2] but in 1902, when the shaft had been sunk to 230 feet, 3,000 tons of ore are said to average 3½ per cent.; and in 1906, a year of two after the Elmore oil plant had been installed, it had fallen to 2.7 per cent.[3] In 1904 the shaft is reported to have reached a depth of 550 feet with drifts from seven levels. It had an inclination of 87° to the north, and the ore bodies are said to be overlapping lenses in slate.[2]

Stripping is said to have shown the vein to extend for a mile; but only one of the other workings appears to have been of much importance. Half a mile west of the main shaft and 230 paces west of the line between sections 15 and 16, some stripping was done about 200 paces north of the road to Hermina mine. The rocks exposed on successive east and west ridges are alternating slate and quartzite with a nearly vertical dip. The stripping, which is extensive, shows from 4 to 6 feet of ore, containing small quantities of chalcopyrite. Two hundred or 300 paces north, after an interruption of drift, the east and west range of granite hills rise much as was described near the main shaft.

A quarter of a mile west of this stripping, where the Hermina road touches a hill of rock to the north, a large amount of work was done, including the driving of a tunnel 120 feet into the hill side. The hill consists mainly of quartzite, but with interbanded green schist, and quartzite extends north for 250 paces, beyond which there is drift. The rock dump at the tunnel shows mainly green schist with vein quartz enclosing some chalcopyrite.

The Hermina Copper Mine

A large amount of work has been done at the Hermina mine where several shafts were sunk along a distance of more than a mile, running from southeast to northwest. The nearest workings to the Massey mine are on a hill about two miles to the west, where shaft No. 1 was sunk to a depth of 400 feet, according to Mr. John Thomann, who was in charge of the property as caretaker. The shaft is in green chloritic schist, but a belt of coarse quartzite runs for 200 paces north 70° east, with a vertical dip a little to the southwest. The green schist is cut by veins of quartz with some chalcopyrite.

Shaft No. 2 is a little northeast of the road on quartz veins in coarse granite, and is said to be about 25 feet deep. Two other small openings in granite with some greenstone occur a little southeast.

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[2] Bur. Mines, Vol. X., p 120. [3] Ibid, Vol. XV., p. 67. [4] Ibid, Vol. XIII., p. 78.

No. 3 shaft, the most important of the Hermina workings, is said by the caretaker to be 500 feet deep. and a large amount of drifting has been done at different levels. The shaft is in a valley between hills of granite, including masses and bands of green schist. No quartzite was observed here. The granite is partly fine grained and partly coarse and pegmatitic. It has entirely the appearance of the Laurentian; and from the low hill tops one can see the pinkish granite and gneiss extending for a long distance to the north.. The rock dump shows much green schist and quartz.

A fifth of a mile northwest of shaft No. 3, there is another small shaft on a large quartz vein in granite, with strips of green schist. Granite and greenstone extend for a mile southwest from No. 3 shaft along the railway to Walford, and the whole surroundings of the mine suggest Laurentian and Keewatin rocks, except for a small patch of quartzite on the road between No. 3 and No. 2 shafts. The presence of this quartzite and of the strip near No. 1 shaft make it probable that both granite and greenstone are later than the Sudbury series.

From the descriptions just given it will be seen that the Massey and Hermina copper deposits follow roughly the contact of the granite with the sedimentary series, but that the ore is mainly found in green schist. They are not contact deposits in the strict sense, however, but may occur a quarter of a mile north or south of the actual contact either in the sedimentary series or in the mass of eruptives. There has been a considerable amount of faulting and fracturing of the rocks along this line, as shown by crush breccias and the numerous quartz veins, though the ore itself is more apt to accompany the schist than the quartz.

HUDSON BAY EXPLORING EXPEDITION
1912

BY

J. B. TYRRELL

M.A., M.Inst.M.M., F.G.S., &c.

Itinerary

On the 18th of April 1912 I received instructions from The Honourable the Minister of Lands, Forests and Mines of the Province of Ontario to organize a party, including a properly qualified Dominion Land Surveyor and assistants, and to proceed at as early a date as practicable direct to Port Nelson at the mouth of the Nelson river on Hudson Bay, and after due investigation to carefully select the lands, waterfront and easements to which the Province of Ontario is entitled under an agreement with the Province of Manitoba, ratified by an Order of the Privy Council of the Dominion of Canada, dated the twentieth of February, 1912.

After these lands had been selected, they were to be properly and accurately surveyed.

As much information as possible was to be obtained about the strip of country lying within fifty miles of the shore of Hudson Bay and extending from the southeastern bank of Nelson river to the western boundary of the Province of Ontario.

And, finally, if possible, I was to return home through that part of the District of Keewatin added by the Act of Parliament of Canada of last session to the Province of Ontario, and now known as the District of Patricia, obtaining such general information as to the character, resources and possibilities of this district as it might be possible to procure in the time at my disposal.

In accordance with these instructions, I engaged Professor Lewis B. Stewart, Professor of Surveying and Geodesy in the University of Toronto, as surveyor, and Mr. W. B. McPherson, B.Sc., as assistant surveyor and chainman, and at the same time made arrangements for an assistant geologist to go by ship to Port Nelson in order to accompany me on my journey home through the District of Patricia. I also engaged Mr. Hugh McDiarmid, of Maxville, Ontario, who had already spent some years on Hudson Bay, as a chainman and canoeman.

On the twenty-seventh of May, 1912, accompanied by Messrs. Stewart and McPherson, I left Toronto and proceeded to Nepigon, where, through the kind assistance of Mr. William McKirdy, four good Indian canoemen were secured, and thence the party proceeded to Selkirk, Manitoba. Here it was necessary to wait for a few days, for the steamboats declined to start for the north end of Lake Winnipeg until it was reasonably certain that the ice had disappeared from it. On the fourth of June we took passage on the steamer "Wolverine," belonging to the Northern Fish Company, and started from Selkirk. The boat was loaded with fishermen and their supplies for the summer, and it was necessary for us to stop at several fishing stations on the shore and islands of Lake Winnipeg on the way north. Nevertheless, we reached Warren's Landing, at the north end of this lake, where the Nelson river flows out of it towards Hudson Bay, on the morning of the sixth of June, and on the afternoon of the same day we continued down the Nelson river to Norway House, where the Hudson's Bay Company has one of its oldest and most important trading posts.

Here it was necessary, if possible, to obtain two more canoemen, for we had three canoes and I needed to have two expert Indian canoemen in each canoe. We had already obtained four such men at Nepigon, but they knew nothing of the waters ahead of them, and I had purposely refrained from engaging more canoemen in Nepigon in order to be able to take two men from Norway House who knew the river from there to York Factory, with its rapids, falls and portages.

Unfortunately others wanted to go to Hudson Bay as well as ourselves. The number of canoemen at Norway House was limited and there was keen competition for them, so that a delay of several days occurred here before men could be obtained. As far as possible the time was employed in correcting instruments and getting everything in order for immediate work when we should reach the field of our proper labours.

Photo by J. B. Tyrrell, July 28, 1912.
Camp at extreme high tide, east shore of Nelson river.

Norway House to Hayes River

Having at length engaged two Indians, we left Norway House on the morning of the twelfth of June in three canoes, with such provisions as would be necessary to supply us for a month, and started northward down the Nelson river to the mouth of the Echimamish, up the Echimamish to its head, across the narrow rocky divide which bounds the waters of the Nelson river on the east, and then down the Hayes river to York Factory, the great historic trading post of the Hudson's Bay Company, built on the west bank of the river near its mouth, making a track-survey of our route, the distances on the rivers and smaller lakes being estimated, while the lengths of the larger lakes were measured with a boat log.

The Shamattawa river flows into the Hayes river sixty miles from where this latter stream empties into Hudson Bay, and as we were to explore a strip fifty miles wide from the shore of the Bay southward I decided to begin our survey at this point. Professor Stewart therefore began a careful survey of the Hayes river downwards from the mouth of the Shamattawa, taking his bearings from the true meridian with a transit, and measuring his distances with a rod and stadia hairs, checked in several places by careful chainage. This survey, which shows both banks of, and the islands in, Hayes river, as well as the mouth of the Nelson river, is shown on the annexed map on a scale of 10 miles to an inch.

At the same time I went up the Shamattawa river for a few days to investigate the character of the country through which it flows.

Our journey from Norway House to the mouth of the Shamattawa, a distance of 260 miles, had been rather slow, as we were constantly delayed by head winds and stormy weather, but on the twenty-seventh of June Professor Stewart started his survey downwards from that point and continued it from that time until July 12th, when he reached the mouth of Hayes river. During the latter part of the time in which Professor Stewart was so occupied, I was at York Factory and on Nelson river making investigations as to the character of the surrounding country, and also of the country extending eastward, obtaining all the information that it was possible to obtain from the Indians who have their hunting grounds in this latter district.

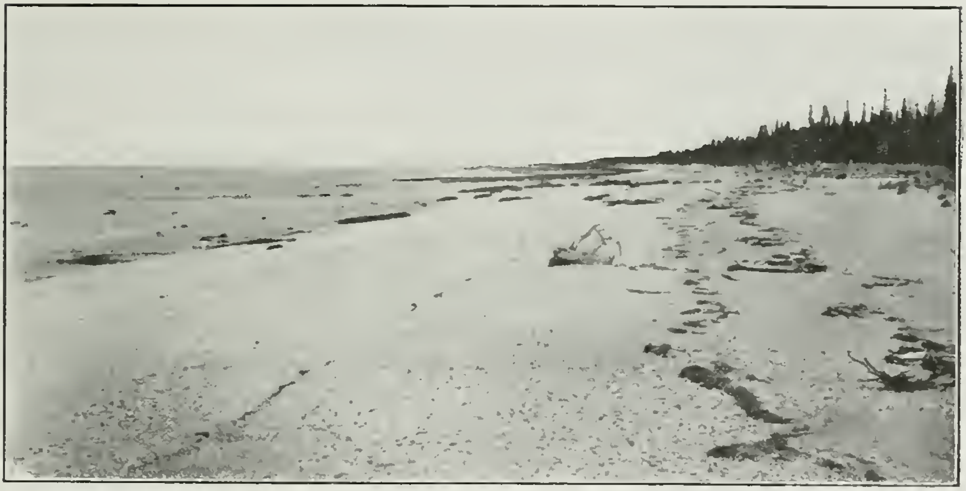


Photo by J. B. Tyrrell. July 25, 1912.
Shore at low tide on the east side of Nelson river. Beach of rounded gravel.

Locating Ontario's Frontage

After Professor Stewart had made the survey of the Hayes river from the Shamattawa river to its mouth, he continued it round the point which separates that stream from the Nelson river, up Nelson river to Seal Island and down its west shore to Flamborough Head. As soon as this was completed I chose a frontage of ten miles on the east side of Nelson river, and Professor Stewart marked it with proper posts and mounds, which I also signed with him. We then cut lines back through the forest for a distance of a mile at the north end of the ten mile strip, and for five and a half miles at its south end, the eastern portion of this latter line crossing the Hayes river and connecting with the stadia survey which had been made of the banks of this latter stream.

After choosing the frontage for the Province of Ontario on the Nelson river it was necessary, in outlining a strip of land five miles wide from that frontage eastward to the western boundary of Ontario, to find a feasible crossing place for a railway across the Hayes river. On account of the shifting character of the channel of this stream near its mouth, and of the enormous floods and ice-jams to which it is occasionally subjected in the spring, such a crossing place could not be found nearer than thirty-three miles from Hudson Bay, not far from the junction of a tributary called the Pennycutaway river which empties into the Hayes river from the west.

Therefore, as it was necessary to go up the Hayes river at least 33 miles before a crossing for a railway could be found, it was also necessary for me to bend the five-mile strip of land southward from the mouth of the Nelson river along the west side of the Hayes river at least as far south as the mouth of the Pennycutaway, and the survey of this strip so chosen was marked by substantial posts at various conspicuous places, as shown on the accompanying map of the lower portions of the Hayes and Nelson rivers.

It was impossible for me to explore the strip of land eastward from the Hayes river to the boundary of the Province of Ontario in the remaining time at my disposal, but I made a trip in a canoe up the Machichi or Fourteen river, which flows northward into Hudson Bay across the country to the east of Hayes river, and obtained a fairly clear idea of the character of the country along its banks. This information, along with such other information as I was able to obtain from Indians and white men living in the country and from an inspection of the shore of the Bay itself, is set down on a later page of this report and on the accompanying map.

Photo by J. B. Tyrrell, Aug. 17, 1912.
Machichi river east of Hayes river, showing cliffs of till.

By the time Professor Stewart had completed the survey of the land chosen for the Province of Ontario in the vicinity of the mouth of the Nelson and Hayes rivers the summer was almost over, and it was necessary for him to return to Toronto to resume his duties at the University, so, accompanied by Messrs. W. B. McPherson and H. McDiarmid and the Indians from Norway House, he returned up the Hayes river to Norway House and thence down Lake Winnipeg to Selkirk and home to Toronto.

On the twentieth day of August the steamship "Stanley" arrived at York Factory, bringing Mr. P. E. Hopkins as assistant to accompany me on my journey homeward.

The annual steamer which brings out the supplies for the Hudson's Bay Company at York Factory had not yet arrived, and some lines of supplies, especially bacon and meat, had run short at this central depot. Consequently the Company was prevented from furnishing the usual supply of meat to its trading posts on the Severn river, which I was about to visit. This was particularly unfortunate for us, because the bacon which had been sent to me on the steamer "Beothic" and delivered to me at the mouth of the Nelson river, was almost all decomposed and quite unfit for use when it was delivered. In spite of its bad condition, however, we were obliged to do the best we could with it and to use parts of it.

From York Factory Home via Severn River

On the twenty-sixth of August I left York Factory, accompanied by Mr. Hopkins and the four Indian canoemen from Nepigon, with two canoes, and took passage in a small sail-boat of the Hudson's Bay Company along the shores of Hudson Bay to Fort Severn, where we arrived eight days later.

On the 4th of September we started southward from Fort Severn in our two canoes heavily laden with provisions, for it was uncertain when or where we would be able to get any further supplies. We ascended the Severn river, hauling our canoes with lines, a distance of fifty-six miles, to the mouth of the Fawn river, which is a beautiful clear stream 150 yards wide at its mouth, with terraced banks 80 feet in height. Thence we ascended Fawn river, walking on the bank and hauling our canoes as before for a further distance of 180 miles, but through much of this distance the journey was made very laborious by the fact that the weather was rainy and stormy and the river was swift, deep and narrow, and overhung with tall willows, so that our progress was often very slow, the tracking line being constantly entangled in the overhanging willows. Fifteen days were occupied in this journey, and at the end of that time we welcomed the occurrence of heavy rapids, past which it was necessary to carry our canoes and supplies, but between which the water was not so swift as before, and it was possible to make some progress with our paddles.

Photo by P. E. Hopkins, Aug. 28, 1912.
Shore of Hudson Bay, near Cape Tatnam.

Trout Lake

On the twenty-first of September Trout lake was reached and we had the pleasure of meeting Mr. H. C. Moir, the gentleman who is in charge of the Hudson's Bay Company's trading post for that Company. Here we were able to replenish our supply of flour, but it was impossible to obtain any meat, and our own supply of meat at that time consisted entirely of partly decomposed bacon.

Up to this time we had travelled from Severn House without anyone who had any local knowledge of the country, and guided entirely by the map on the scale of sixteen miles to the inch published by the Geological Survey of Canada. From Trout lake southward across the height of land to Cat lake, on the waters of the Albany river, the route

Photo by J. B. Tyrrell, Sept. 4, 1912.
Dwelling house at Fort Severn, near the mouth of Severn river, District of Patricia, Ontario.

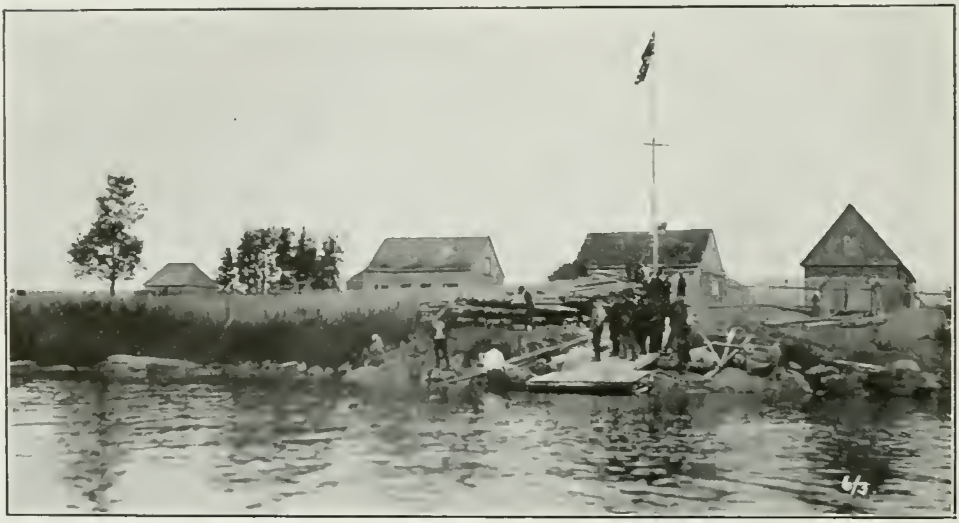


Photo by P. E. Hopkins, Sept. 24, 1912.
Hudson Bay Company's post at Trout lake, District of Patricia, as seen from the lake.

travelled by the Indians was not known, and as we wished to follow it, it was advisable, if possible, for me to employ an Indian here to go with us and show us the way by which he was accustomed to travel. The Indian obtained for us by Mr. Moir was a man of considerable intelligence named Adam Thunder, and on the morning of September the twenty-fourth we started across Trout lake with Adam and his wife and two children in a canoe of their own as guides.

Making for Cat Lake

From Trout lake we entered a small stream named Mishwamágan or Red Sucker river, and ascended it southward to its source in several small lakes, from one of which we carried our canoes and contents across to Kwiuswagami lake and thence into Makoop lake, which empties by an independent outlet westward into Severn river. Makoop lake is evidently good fishing ground, and some Indians have here two substantial log houses in which they live in the winter, although they move about from one part of their fishing ground to another in the summer.

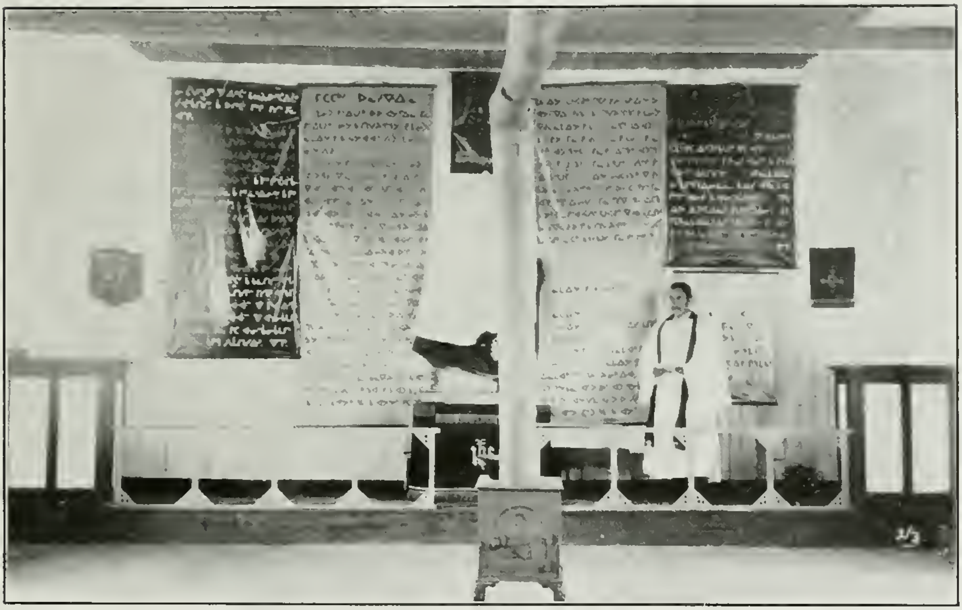


Photo by P. E. Hopkins, Sept. 24, 1912.

Interior of mission church at Trout lake, with Rev. Mr. Dick on right. The Lord's Prayer, etc., in Indian characters.

From Makoop lake, instead of turning down stream, we entered Negigamo or Otter river and ascended it for a day's journey, when, though it was still a stream of considerable size, we left it and turned westward across a portage somewhat more than a mile in length to another tributary of Severn river, which, at the point we reached it, was ninety yards wide with low swampy banks on both sides.

On this river Adam, our guide, decided to leave his wife and family with some friends or relatives whom he met, and to take a seat in one of our canoes, where he would be more useful to us, both by assisting in paddling, and, being close at hand, he would be able to give us information about the country from time to time as the various features were observed.

This river is also a tributary of the Severn, but Adam said that it had no particular name. I have therefore called it Ningitowa river taking the name of one of the lakes

Photo by P. E. Hopkins, Oct. 17, 1912.

Lunch time on the banks of Cat river.

Photo by J. B. Tyrrell, Oct. 4, 1912.

Woods at the north of unloading portage, north of Weagamow lake.

on its course. We ascended it for three days through many lakes and over numerous portages to a lake with a name too long for intelligent English pronunciation, but it means Big White Fish lake.

From the south side of this lake is a portage twelve hundred yards in length across a rocky hill to a small winding stream which in a short distance flows into Weagamow lake, and this lake in its turn discharges by another independent stream westward into Severn river, and is fed by two streams from the east and south, known respectively as the Caribou and Saskatchewáwa.

Weagamow lake also seems to be a good fishing ground, for there was a large band of Indians camped near the place where we entered it, engaged in catching a supply of fish to feed them through the autumn and winter.

From Weagamow lake I had hoped that our route was to take us down stream to the Severn river and thence southward up the main river, but in this I was disappointed, for instead of turning down stream we entered Saskatchewáwa river and ascended it to a small lake named Agutua lake, from which a number of high sand hills may be seen forming conspicuous features in the landscape.

Photo by J. B. Tyrrell, Oct. 7, 1912.
Sandy shore of Windigo lake.

Windigo Lake

From the southwest side of this lake we made a portage three and a half miles in length, over one of these sandy hills to Windigo lake, the largest body of water that we had encountered since leaving Trout lake. This, too, is a favourite fishing ground for the Indians, and on its eastern shore they have some small houses around which were gardens, where potatoes had been grown, though at the time of our visit they had been dug and were stored away. Windigo lake also discharges westward into the Severn river by an independent stream, which, however, we were unable to visit, but we were told by Adam that it flowed westward to Niskib or Goose lake, in which it was joined by Weagamow river, and from which the united streams flowed into Severn river. Passing through the lake we ascended a small river for about fifteen miles, when, by a series of long portages, we passed out of it and into the Cedar branch of the Severn river, which we reached at Little Cedar or Geechika lake, the northern limit of growth of cedar trees.

Thus, on leaving Trout lake, we had ascended a small stream to the higher land lying between the watersheds of the Severn and Wenisk rivers, on which are a number of lakes, and we had travelled southward on the western side of the height of land through a chain of lakes, instead of travelling continuously up the main branch of the Severn river. This route leads through small streams and over many long and swampy portages which are often poorly cut out, but the reason why it is used by the Indians instead of the main river doubtless is that it leads through lakes in which fish are abundant, and where game is probably moderately plentiful. Whether it is easier for large canoes to navigate than a route up the main river is uncertain, because the river is as yet largely unexplored.

Photo by J. B. Tyrrell, Oct. 9, 1912.

Sandy shore of Geechika or Little Cedar lake, with small cedar tree just behind the figure.

From Little Cedar Lake we journeyed southward up a small winding stream and over many portages to the height of land dividing Severn from Cat river, which is one of the upper tributaries of Albany river.

Cat Lake

On the thirteenth of October, we paddled up to the Hudson's Bay Company's post on Cat lake, and were kindly received by Mr. Lawson, the store-keeper in charge for the Company, and, as he was supplied with provisions for the winter's trade, we were able to get such staples from him as were necessary to carry us through to our destination at Sioux Lookout, on the Grand Trunk Pacific railway. A supply of nice fresh bacon was particularly welcome, as we had become very tired of living on rotten bacon, and besides we had that day eaten the last of both that and our sugar, so that we were quite ready for a new supply.

We were now in the country that had previously been surveyed by explorers from the Geological Survey of Canada, and, as the season was far advanced, we made all haste southward down Cat river to Lake St. Joseph, across a portage to Root river, down Root river to Lac Seul, and thence southward to Sioux Lookout, where we arrived on the evening of the twenty-third of October, seven weeks from the date when we left the mouth of the Severn river. Here our canoes were stored, the men were taken eastward to Nepigon and paid off, and I and my assistant, Mr. Hopkins, returned to Toronto.

Surveys

During the season the following surveys were made, namely:

Survey of the mouth of the Hayes and Nelson rivers, with transit and chain, rod and stadia .... 110 miles.

Photo by P. E. Hopkins, Oct. 14, 1912.

Our canoemen after arrival at the Cat lake trading post, with the trader and his boy on the right.

Track surveys where the distances on running water were estimated; on quiet water were measured with a Kay boat log; the lengths of portages were measured by pacing; the directions were taken with a compass checked by numerous observations for variation; and the whole survey was checked by numerous observations for latitude taken in a mercurial artificial horizon with a sextant of 7-inch radius.

		miles.
Echimamish river	water	36
	2 portages	
Hayes river, from source to Shamattawa river	water	260
	27 portages	4.25
Shamattawa river	water	40
Machichi river	water	20
	portages or on foot	5
Severn river to Trout lake post	water	285
	17 portages	2.25

		miles.
Severn river and tributaries; above Trout lake post	water	200
	57 portages	19.75
Albany river waters	water	20
	10 portages	3
In addition to which we examined the following routes, though without making definite surveys:		
Shore of Hudson Bay, Nelson river to Severn river		240
Albany and Winnipeg rivers	water	180
	19 portages	2.75
Total		1,428.00

DISTRICT OF PATRICIA

Physical Features

The District of Patricia is situated a short distance east of the geographical centre of Canada, between north latitudes 50° and 57°, and west longitudes 81° 30′ and 95° 15′, being bounded on the west by the Province of Manitoba, on the south by the older districts of Ontario, from which it is separated by the Albany and Winnipeg rivers, and on the north and northeast by Hudson Bay.

It is roughly triangular in shape, with a greatest length in a N.E-S.W. direction of 630 miles, and a greatest width in a N.-S. direction of 390 miles, and it has an approximate area of 150,000 square miles, or about one-fourth larger than the combined areas of Great Britain and Ireland.

It lies entirely within the drainage area of Hudson Bay, most of its surface being drained directly into the Bay through the Severn, Winisk, Trout, Ekwan, Attawapiskat and Albany rivers, though there is a small area in the southwestern portion of the district which is first drained westward into Lake Winnipeg, before its waters find their way by the Nelson river into Hudson Bay.

It has a shore line on Hudson Bay of 600 miles. The shore is low and flat, and for most of its length is marked by a beach of sand and gravel. From this beach the water recedes for a long distance at low tide, leaving a tidal flat which in places is hard and sandy, while in other places, especially near the mouths of rivers, it is soft and muddy, and is often dotted with boulders.

Back from the beach the land rises very gently in an alternating series of marshes and gravel ridges, the latter of which represent old shore lines when the land was lower than it is at present. The marshes are covered with grasses and sedges, for the forest does not usually descend below a line several miles distant from high water mark.

Low points of limestone are said to be exposed on the shore west of Cape Henrietta Maria, but elsewhere the beach is of sand, gravel, or mud, without sign of rock in place.

The District is a fairly distinct physiographic unit with its highest portion, consisting of a rocky granitic plateau with an elevation of 1,500 feet above the sea, in north latitude 52°, west longitude 92°. From this elevated area all the principal rivers in the district take their rise, and radiate to the several points of the compass, though the water from all of them finally reaches Hudson Bay.

Last summer our course across the district from the mouth of the Severn river to Lac Seul took us over the highest portion of this elevated area, the distance in a straight line between the extreme points being 440 miles, though the actual distance travelled would nearly double this figure.

From the highest point of land crossed, which has an elevation as determined barometrically of 1,470 feet, the country slopes gently southward to Lac Seul, at the average rate of three feet to the mile, and throughout the distance the surface is exceedingly rocky, with occasional sand plains and ridges. Lakes are very numerous, being simply bodies of water filling the depressions in the rocky surface.

North of the highest point of land the country slopes northward at an average rate of five feet to the mile. For the first hundred and fifty miles down this gentle slope the surface is often rough and irregular, with many sandy or stony hills and occasional rocky ridges, between which the intervening valleys are generally partly filled with clay or sand. Lakes are not as large or numerous as they are south of the high land, and such as do exist lie in shallow basins in the glacial clays, and not in rock basins, while most of the land between the waterstretches consists of clay, sand or glacial debris of some kind with low surface relief. The country is well watered, but the general impression which prevails with regard to the character of much of northern Canada, namely, that it is an extensive rocky country with bodies of water lying between the rocky hills, does not often apply here. To the south of the high land such is the character of much of the country, but to the north of it the rock basins are mostly filled with surface deposits, and the lakes are merely bodies of water filling shallow depressions in these surface deposits, irrespective of the underlying rock.

Trout lake lies near the northern boundary of this broken country with its irregular, variegated surface. From Trout lake northward to Hudson Bay, the slope continues as before at the rate of about five feet to the mile, but the rock soon disappears under glacial and postglacial deposits, and thence northward the country is covered with an even mantle of glacial clay or till, which in its turn is often covered with stratified marine clays and sands holding shells of *Saxicava rugosa*, and other marine bivalves.

Photo by P. E. Hopkins, Oct. 17, 1912.
Indian summer on Cat river, showing characteristic forest on the banks.

Extensive Peat Bogs

As this northern country is very new, geologically speaking, extensive valleys have not been formed in it, and the rainfall has no means of running off except in the narrow, immature channels of the rivers. Consequently great areas are still flat, and practically undrained, and such flat areas are now covered with peat bogs on which grow scattered forests of small stunted spruce and larch.

This boggy plain not only extends to Hudson Bay on the course of the Severn River, but it also stretches northward and westward from the Severn river to the lower portion of the Hayes river, and all the country within fifty miles of Hudson Bay between the western boundary of Ontario and the Hayes river is undoubtedly of this flat, bog-covered character. All the evidence that it was possible for me to collect pointed distinctly and conclusively to the fact that there are no rocky hills anywhere in this fifty-mile strip. However, near the southern boundary of this strip, or more probably a little to the south of it, there is a ridge of sand and gravel with lumpy gravel hills rising on it here and there, and near these hills are several small lakes. It was impossible for me to visit these hills and lakes in the time at my disposal, but the description given to me of them would indicate that they were part of a moraine of the Labradorean glacier which was laid down in water, and was afterwards modified by the action of waves, which gave rise to the formation of beaches. The exact position and character of this ridge should be carefully and thoroughly investigated before a route is finally chosen from the western boundary of Ontario to the Hayes river.

East of the Severn river the plain underlain by glacial clays and marine sediments has been traced by other observers around to the Albany river, and the total area included in it would seem to be about two-fifths of the whole district, or about 60,000 square miles.

Lake Elevations

In order to give a clearer idea of the heights of different parts of the country the following elevations of some of the lakes passed through may be recorded, all the heights, except that of Lac Seul, being determined by readings of an aneroid barometer.

	Feet.
Lac Seul	1,140
Lake St. Joseph	1,220
Smooth Rock Lake	1,300
Cat Lake	1,330
Whitestone Lake	1,390
Height of Land Lake	1,470
Big Cedar Lake	1,400
Little Cedar Lake	1,250
Windigo Lake	1,200
Weagamow Lake	1,000
Trout Lake	770
Hayes River Route:—	
Whitewater Lake	695
Oxford Lake	585
Knee Lake	550
Swampy Lake	500

Forest

The district as a whole, as far as could be seen from our line of travel, was not heavily forested. Here and there groves of trees of moderate size were growing on the slopes of hills, or on the well-drained banks of the valleys, but as a rule most of the timber was small, and much of it had been burned in comparatively recent years.

White and Red Pine (*Pinus strobus* and *resinosa*) are growing on sandy flats on the banks of Lac Seul.

Banksian Pine (*Pinus banksiana*) is growing of good size on a sandy plain on the banks of Fawn river below the mouth of Otter river.

Cedar (*Thuya occidentalis*) grows north as far as Little Cedar lake on Severn river, though it was not seen anywhere in great abundance.

Black and White Spruce (*Picea nigra* and *alba*) extend north to within sight of the shore of Hudson Bay.

Larch or Tamarac (*Larix americana*) is associated with white and black spruce to the northern limit of the district, but unfortunately most of the trees are dead.

White Birch (*Betula papyrifera*) is found growing freely as far north as the most northerly outcrops of Archæan rocks, and some scattered trees were seen farther down the Severn river.

Aspen Poplar (*Populus tremuloides*) grows as far north as a sandy ridge a few miles above the mouth of Fawn river, though the trees are there very small.

Balsam Poplar (*Populus balsamifera*) occurs on the islands and banks of the rivers to within a short distance of Hudson Bay.

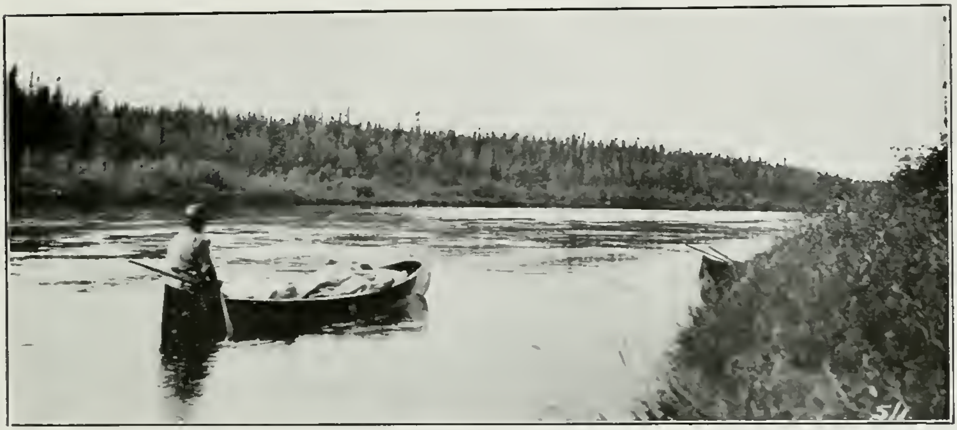


Photo by P. E. Hopkins, Sept., 1912.
Tracking up Fawn river. Flat boggy country on both sides.

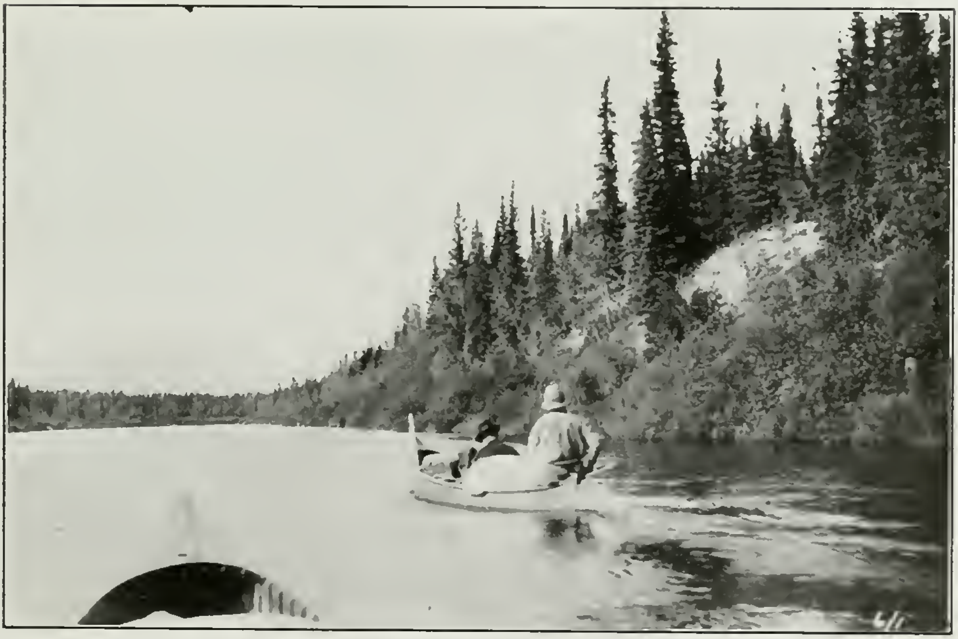


Photo by P. E. Hopkins, Sept., 1912.
Fawn river in high water, showing the bank overhung with willows.

Climate

Little can be said on this subject, as my opportunities for observation were very limited. We left the shore of Hudson Bay on the 4th of September, and had windy and rainy weather for several days, or until we reached the vicinity of the mouth of Fawn river. After that we had some rain almost every day, with intervening periods of bright, clear weather, until we reached Trout lake on the 21st of September. During the last week of this time the leaves of the poplars, birches, and willows had assumed their brilliant autumn colours. In Manitoba the leaves on these trees would be changing colour at the same time.

On the 25th of September, while in the rock country just south of Trout lake, we had a moderately heavy fall of snow, after which, until the 23rd of October, when we reached the Grand Trunk Pacific railway, the weather was bright and mild with a few light showers of rain, but no more snow.

At my suggestion the Director of the Meteorological Service of Canada has consented to establish an Observing Station at Trout lake, so that within a very few years we shall have much more exact information about that important locality.

Inhabitants

The Hudson's Bay Company has a trading post just at the mouth of Severn river, and another at Trout lake, at each of which two white men are stationed. Doubtless a few more white men live at other trading posts farther east, but the total white population of the district is very small.

The native population consists of Crees and Ojibways, who are scattered here and there over the whole country, mostly on the banks of lakes and streams where a supply of fish can be depended on for food, and where fur-bearing animals can be caught, with the skins of which they may purchase ammunition, implements, clothing and such articles of white man's food as they may consider necessary.

In several places little groups of houses were seen in which the Indians pass the winter, and we were told of other groups of houses off our line of travel. When we passed them the houses were not occupied, and the Indians were away hunting or fishing elsewhere.

The people seemed to be generally healthy and comfortable. With the exception of a few coats and blankets or rabbit skin, they dress entirely in clothing obtained from the traders. The total Indian population of the district, as given me by Mr. D. C. Scott, Secretary of the Department of Indian Affairs for Canada, is as follows:—

Indians receiving pay from the Government under Treaty:—

Osnaburg	290	
Fort Hope	479	
Martin's Falls	99	
Fort Albany	741	
		1,609

Indians estimated:—

Fort Severn	250	
Trout Lake	500	
Winisk River	250	
Attawapiskat	150	
Sandy Bay	100	
Cat Lake	150	
		1,400
Total		3,009

Photo by J. B. Tyrrell, Oct. 13, 1912.
Woods on the portage past Pesew falls, just north of Cat lake. An Indian letter on the tree in the centre.

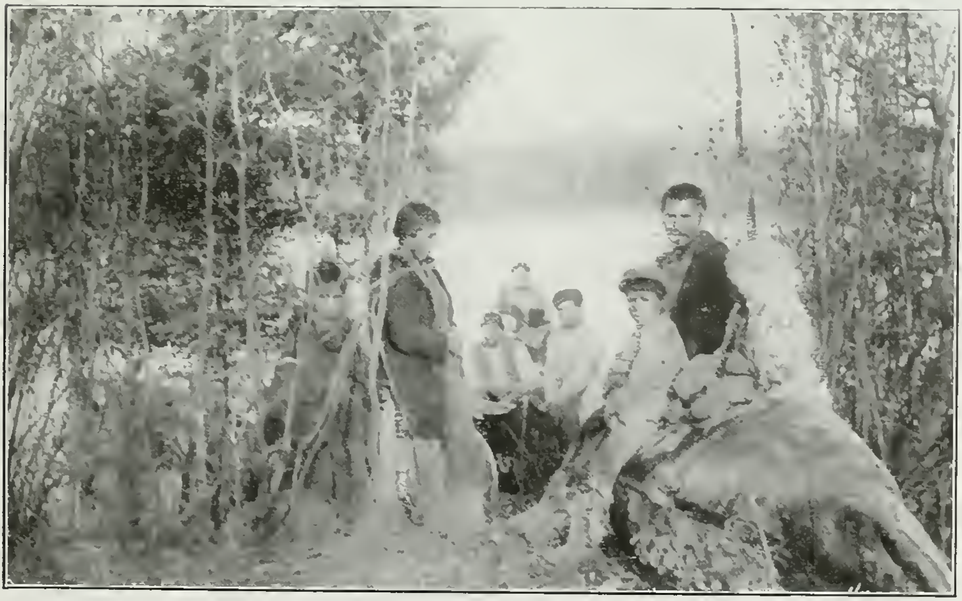


Photo by P. E. Hopkins, Oct. 2, 1912.
Indians on the bank of Ningitowa river. The boy sitting on the canoe is dressed in a coat of rabbit-skin.

Animals

Animals did not seem to be particularly plentiful anywhere throughout the district.

Polar bears (*Thelassarctos maritimus*) are occasionally found on or near the coast of Hudson Bay.

Black bears (*Ursus americanus*) roam through the forest almost everywhere.

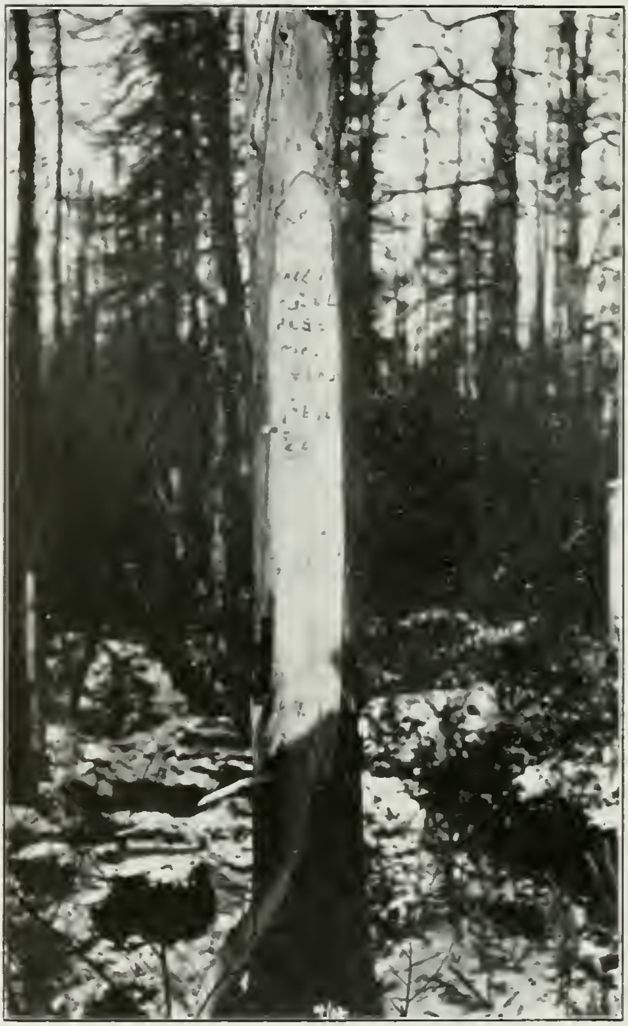


Photo by P. E. Hopkins, Oct. 11, 1912.
Indian letter on portage on Severn river. "It was morning when the white chief passed very near the freeze up."

Barren Ground caribou (*Rangifer arcticus*) appear to regularly frequent the open country along the shore near and to the west of Goose river during the summer, turning inland in a westerly direction on the approach of autumn, whence they are said to go westward to spend the winter in the vicinity of Split lake, returning eastward again to the coast in the following spring.

The annual migration of this herd of caribou has often been observed. In May, 1792, David Thompson speaks of watching a vast herd cross the Hayes river in an easterly direction about twenty miles above York Factory. It took two days to cross the river, and he estimated that it included several million individuals. At the present time, it is said that the herd usually crosses the lower portion of the Shamattawa river on its way inland in the autumn.

Woodland caribou (*Rangifer caribou*) are found scattered in small numbers throughout the district.

Moose (*Alces americanus*) are fairly abundant throughout the district as far north as Trout lake, and a few are occasionally met with to within 75 miles of Hudson Bay.

Virginia deer (*Odocoileus virginianus*) are occasionally killed near Lake St. Joseph, but they do not occur much farther north.

Photo by P. E. Hopkins, Sept. 24, 1912.
Rev. Mr. Dick with his pet black fox at Trout lake.

Of the smaller fur-bearing animals, the following are the most abundant, and the trade in them has constituted the chief industry of the country up to the present time: Black, cross and red foxes (*Vulpes vulgaris*), lynx (*Lynx canadensis*), Otter (*lutra canadensis*), marten (*Mustela americana*), Mink (*Putorius vison*), Weasel (*Putorius vulgaris*), Skunk (*Mephitis mephitica*), Beaver (*Castor fiber*), and Muskrat (*Fiber zibethicus*).

Waterfowl are not very abundant, except on the coast of Hudson Bay, but a few ducks breed on the rivers and lakes, and geese fly over the country in considerable numbers during their spring and autumn migrations.

Both the ruffed grouse and the spruce grouse (*Bonasa umbellus* and *Canachites canadensis*) were found everywhere in the woods throughout the district, though nowhere in great abundance. The sharp-tailed grouse (*Pedioecetes phasianellus*) seemed to be fairly abundant near Makoop Lake, and the willow ptarmigan (*Lagopus lagopus*) was found in the open country near the shore of Hudson Bay

Fish form the staple food of the inhabitants of this country. The principal kinds so used are trout, whitefish, tullibee and suckers.

Photo by J. B. Tyrrell, Oct. 2, 1912.

Clay plain beside Ningitowa river.

Minerals

No minerals of economic importance have yet been recorded from the vicinity of the route travelled over last summer, but there is little doubt that fuller investigation will determine their existence.

Several areas of greenstone and other similar rocks of Keewatin age were crossed, especially on Trout, Windigo and St. Joseph lakes. Wherever rock of similar age and character to these have been thoroughly prospected in other parts of Canada, valuable minerals, usually including the precious metals, have been found in them, and there is no reason to suppose that the areas of Keewatin rocks here recorded will form exceptions to this rule. The Palæozoic limestone near the shore of Hudson Bay may also contain beds of salt, gypsum or other valuable minerals of similar character.

Agriculture

In other parts of this report, and especially under the description of the geological features of the country, I have shown that there is an enormous area consisting of fifty or sixty thousand square miles of country underlain by glacial clays, or marine clays and sand, and that also north of the highest part of the land, there is a large additional area of unknown extent covered with loose glacial detritus of varying composition. Most of this country is now wet and undrained, and has a particularly uninviting and repellant appearance. However, much of it has a sufficient slope to permit of drainage, and as the clays themselves possess those qualities which should make rich fertile soil, the agricultural possibilities of the country are limited only by the climate, of which but little is yet known.

During the past summer, Mr. Moir, of the Hudson's Bay Company, and the Rev. Mr. Dick, the missionary, raised excellent crops of potatoes at Trout Lake on small patches of ground, and Indians also had good fields of potatoes at a number of other places in the district. Some years ago, the officer then in charge of the trading post at Trout lake for the Hudson's Bay Company kept cattle, and cultivated all the ordinary garden vegetables commonly raised in Manitoba, but the cattle were ordered to be killed, and all cultivation, except that of potatoes, was discontinued, for these grow freely, with very little expense for care and attention. I strongly recommend that suitable steps be taken to ensure the establishment of an experimental farm or garden at Trout lake, either with the co-operation of the Department of Agriculture of the Dominion of Canada, or by the Government of the Province of Ontario itself.

Photo by H. C. Moir, Hudson Bay Co.

Digging the garden at Trout lake.

Rivers Flowing Into Hudson Bay

The principal rivers flowing into the west coast of Hudson Bay, beginning at the north and proceeding southward, are:—

	Length.
Dubawnt with Chesterfield Inlet	900 miles
Kazan	500 "
Thlewiaza	300 "
Seal	250 "
Churchill	1,000 "
Nelson—Saskatchewan	1,700 "
Hayes	320 "
Severn	420 "
Wenisk	400 "
Attawapiskat	465 "
Albany	610 "
Moose	340 "

The exploration of the past summer had to do with only three of these rivers, namely, the Nelson, Hayes, and Severn, and, consequently, the remarks here made will be confined almost exclusively to these three streams.

As will be explained later, the land around Hudson Bay was formerly, relatively to sea level, depressed about 400 or 500 feet lower than it is now, and consequently the water covered much of what is now land, and the area of the Bay was considerably greater than it is at present.

On the western shore of the Bay, the land, even when the water stood at its highest level, sloped gently downwards into the sea, and erosion cliffs, marking old strand lines, are conspicuously absent. This feature is equally prominent on the present shore, for the land now rises very gradually back from the gravel beaches which form the confines of the water area of the Bay. From Eskimo Point, in north latitude 61° 04′, down the coast all the way to the mouth of the Moose river, there does not appear to be a single wave-cut cliff facing the ocean.

Photo by J. B. Tyrrell, July 12, 1912.
Tidal shore on west side of Hayes river, a short distance below York Factory.

The three rivers last mentioned flow down this gentle regular slope, and at and near their mouths have cut gorgelike valleys into the marine and glacial clays sometimes down to the underlying hard rock. All have many features in common.

The Severn

The Severn river, below Limestone rapids, where it has last cut down to the underlying rock, has a very juvenile character. Its banks are steep and often precipitous, with glacial clays at the bottom and marine clays above. Nearer the mouth the glacial clays disappear, and stratified clays and sands form the whole thickness of the sediments exposed in the banks. In places its channel is broken by islands, those higher up the stream being for the most part fragments cut off from the adjoining country as the river deepened its channel, while those nearer the mouth on the contrary have either been partly built up by sediments brought down by the current, or represent the old bed of the river past which the stream has cut new channels in comparatively recent times.

The Hayes

The Hayes river is similar in character to the Severn. Both are from half a mile to a mile in width ten miles above their mouths, with currents of about three miles an hour, the low islands within the tidal portion of the Hayes river being if anything more conspicuous than in the Severn. In both cases the rivers themselves are now cutting away the steep banks on their western sides, and are building low flats on their eastern sides.

Two opportunities presented themselves of measuring the rate at which the latter river cuts away its banks. In the year 1900 the Hudson's Bay Company had a reserve surveyed around York Factory, and posts were planted at the north and south ends of this reserve close to the top of the bank, or rather 75 and 20 feet respectively from it. The post at the north end is now 35 feet from the top of the bank, 40 feet having been washed away in twelve years, and the post at the south end has been washed away entirely, and a measurement from the southwestern corner of the reserve shows that about 35 feet of the bank has been carried away. These measurements would indicate that the river was cutting away its west bank at the rate of about three feet in a year.

Photo by J. B. Tyrrell, July 13, 1912.
Site of old York Factory on the bank of Hayes river, about half a mile below the present fort. On the left of the picture is a cellar of one of the old houses, with some of the timbers which covered it.

Half a mile north of the site of the present York Factory is the site of old York Factory, from which the trading post of the Hudson's Bay Company was removed in

1789. Fortunately, we have a survey of this site made by Joseph Robson in 1745, which shows a little stream with four bends within or close to the stockades of the Fort. These bends of the stream provide an excellent measure for determining the former position of this Fort and of the shore line in front of it. Two of the bends have already disappeared, having been washed away by the stream, the other two being quite recognizable by a comparison of the old plan and one made at the present time. These two plans show distinctly that the bank has been cut back a distance of 168 feet since Robson's plan was made one hundred and sixty-seven years ago, or a recession of practically one foot a year in that time.

Another point of great interest is shown by the site of this old Fort. The line of the bank now cuts through a cellar which was evidently under one of the old houses at the Fort before it was destroyed by the French in 1782, and this cellar is now just at the top of high tide. As it is not likely that it was dug below high tide level, where it would have been subject to constant floods, it furnishes corroborative evidence to that which I obtained at Churchill in 1893 and 1894 that the land around Hudson Bay has reached a condition of stability.

Similar evidence of the present stability of the land is furnished by the existence of trees more than one hundred years old close to tide water on the banks of the Nelson river, and the strength of the beaches of sand and gravel which in many places form the present shore of the Bay would also indicate stability of the land for a moderate length of time to enable such strong beaches to be formed.

While it is evident, therefore, that the land on the shore of the Bay has now ceased to rise, it is equally evident from the character of the clay-covered plain around Hudson Bay, and the newness of the raised beaches on that plain, that it has risen several hundred feet within geologically recent times.

The Nelson

The Nelson river differs somewhat from the two rivers of which we have just spoken. Like them, and in fact like all the rivers flowing into Hudson Bay, it is cutting into the cliffs on its west bank, but unlike the Hayes and Severn rivers, these cliffs are of glacial till and not of marine sediments, and the bed of the river to its mouth is composed of similar hard till or hardpan, into which the river is actively cutting its channel. As the river is everywhere cutting down and deepening its channel, it is not now building up islands like those near the mouth of the Hayes river, but is carrying all the sediment derived from the bottom of the channel and from the bank on its western side down into the Bay. The two islands in the upper portion of the mouth of the river, namely, Seal and Gillam islands, are fragments cut off from the surrounding country by diversion of the channel, and have not been built up by the river itself.

The stream fills the lower portion of the valley of Nelson river from side to side. In places terraces may be seen at the mouths of tributary streams, such as at the mouth of the Seal river, a small tributary from the south, but if any terraces have existed in the main valley itself they have been swept away. The river has all the appearance of having originally been cut out by a smaller stream, probably the lower continuation of the Burntwood river, which drains a considerable portion of the country between the Saskatchewan and Churchill rivers. Afterwards a larger stream was introduced into it, and this stream is now actively widening and deepening the old valley, forming precipitous cliffs on one or both sides.

The facts that the stream is flowing over a bed of boulder-clay into which it is actively cutting its channel, and that it is not filling up its bed at its mouth, are of great importance in the consideration of any harbour improvements that may be made in it, for this boulder-clay, which however contains few boulders, can be readily dredged, and at the same time the dredged areas, if arranged so that they may be scoured out by the current, will have no tendency to fill up, and the excavated channels will remain as permanent improvements, much the same as if they had been excavated in solid rock.

In this connection it may be noticed that the Nelson river above the influence of high tide is practicaly a river of clear water, carrying very little sediment, and the mud which is held in suspension by the water in the mouth of the river is derived largely from the bottom of the river itself or from the clay cliffs which form its banks. If these cliffs are protected from denudation, and if the river below Seal island is diked into a channel of even width, so that the water will not spread out over the shallow clay flats on both sides, the water would probably be clear where it flows into the Bay, and there would be no trouble whatever in keeping a channel open out into the deeper water of the Bay. Such dykes as I have spoken of could be built by the dredge which was digging the channel, and they would prevent the incoming tide from spreading out over a very large area, and would consequently decrease the tremendous current which is now caused at the mouth of the river by both the flowing and the ebbing tide.

It is thus seen that the Nelson river differs materially from the other rivers flowing into Hudson Bay, and this difference is doubtless caused by the fact that the large stream draining Lake Winnipeg took possession of the lower portion of the smaller valley, probably of Burntwood river, in very recent times, and is now actually widening and deepening this older and smaller valley.

Photo by J. B. Tyrrell, July 25, 1912.
Shore on the east side of Nelson river at low tide. Boulders are lying on a hard till.

Geology

The rocks met with during the summer may be considered under the following heads in ascending order:—

ARCHÆAN.—Composed of granites, gneisses, greenstones, gabbros, anorthosites, and other igneous or highly altered sedimentary rocks such as are found almost everywhere throughout northern Canada.

It is probable that all these rocks should be included in either the Keewatin or the Laurentian series.

PALÆOZOIC.—Ordovician and Silurian limestones and dolomites, mostly flat-lying. They overlie the Archæan Complex and extend southward from the south shore of Hudson Bay for a distance of sixty miles or more.

PLEISTOCENE deposits, consisting of tills and glacial and inter-glacial clays and sands, with occasional beds of peat or lignite.

RECENT deposits, composed of clays and sands laid down at or near the mouths of the rivers on Hudson Bay, and marine clays and sands, which extend inland from the Bay for varying distances up to about one hundred and fifty miles. The sands in many cases represent old shore lines. Besides these, the recent deposits include beds laid down in fresh water lakes and in the bottoms of the valleys of existing streams.

Archæan

The Archæan rocks outcropping in the country northward from Sioux Lookout on the Grand Trunk Pacific railway to Cat lake have been described by Dr. A. W. G. Wilson in a report to the Geological Survey of Canada, and as my observations added very little new information to that collected by Dr. Wilson, it is unnecessary for me to repeat here what he has already said, more especially as the rocks are mostly granites and gneisses, such as are commonly found in many parts of northern Canada and are usually classed as of Laurentian age, though associated with them are a few narrow bands of greenstones and amphibolites, some of which may be of Keewatin age.

Laurentian

Laurentian rocks, similar to those on Cat lake and river, were also found along the canoe route northward from Cat lake through Whitestone lake, across the height of land, down the Cedar branch of the Severn river to Cedar lake, and thence northeastward to the vicinity of Windigo lake.

On Windigo lake, rocks of Keewatin age were encountered, but these are described more in detail below. From Windigo lake northward through Weagamow and Makoop lakes, similar Laurentian rocks occur all the way to Trout lake, the south shore of which is formed of a rather prominent granite ridge. On Trout lake another belt of Keewatin rock occurs. On the northern side of this lake, Laurentian granites and gneisses again make their appearance and outcrop for a distance of sixty-one miles down the Fawn river, when they finally disappear under an overburden of surface clays and sands.

These Laurentian rocks are all of very similar character throughout, and the following descriptions by Mr. Ellis Thomson of specimens collected at various places along our line of travel will give a fair idea of their general character.

Portage 42, Windigo river.—A gneissoid rock of fairly fine grain, composed chiefly of quartz, orthoclase, microcline, biotite, and muscovite, but containing also considerable quantities of plagioclase, chlorite, and epidote. Apatite and magnetite are prominent accessory constituents the latter altered in places to limonite. It is a typical two-mica gneiss of fairly fine texture.

Mouth of Mishwamagan river.—A granitoid rock of gneissoid structure, composed for the most part of quartz, orthoclase, microcline, and biotite. Considerable plagioclase is also present. Apatite, magnetite, and limonite are more or less important accessory constituents, the first-named being quite prominent. Considerable of the biotite has been altered in places to epidote. It seems to be a biotite gneiss of medium grain, although scarcely schistose enough to be quite typical.

Trout lake at head of Fawn river.—A granitic rock, composed chiefly of quartz, orthoclase, biotite, and green hornblende in about equal amounts. Microcline and plagioclase are other feldspars present. Apatite, magnetite, and pyrite are all fairly common accessory constituents, while there are considerable quantities of chlorite and epidote present as alteration products of the hornblende and biotite. It may best be described as a hornblende-biotite granite.

Lowest granite outcrop on Fawn river.—A granitic rock of gneissoid structure composed chiefly of microcline, quartz, and biotite. Orthoclase and plagioclase are also present in subordinate quantities, while apatite and magnetite are prominent accessory constituents, the former as short stout crystals. A little muscovite is also present, and both the micas have been altered in places to chlorite and epidote. The quartz and the feldspar show a graphic intergrowth in some places. This specimen gives a beautiful illustration of the gridiron structure in the microcline.

Portage 20, Negigamo river.—A very schistose rock, consisting almost entirely of green hornblende and quartz grains. Magnetite is a rare constituent. The hornblende is slightly altered in places to chlorite. A typical hornblende schist.

Keewatin

Two important bands of rocks of this series were encountered during the summer within the district of Patricia, one at Windigo lake and the other at Trout lake. It is possible that other narrow bands of similar rock may have been crossed along the line of travel, but if so they were hidden by the overburden of sand and clay, and it was impossible to see them.

In the southern expansion of Windigo lake, green gabbros and diabases were seen in a number of places along our course. As a rule, they did not appear to have any very definite dip or strike, and no quartzites, conglomerates, or other clastic rocks were found associated with them.

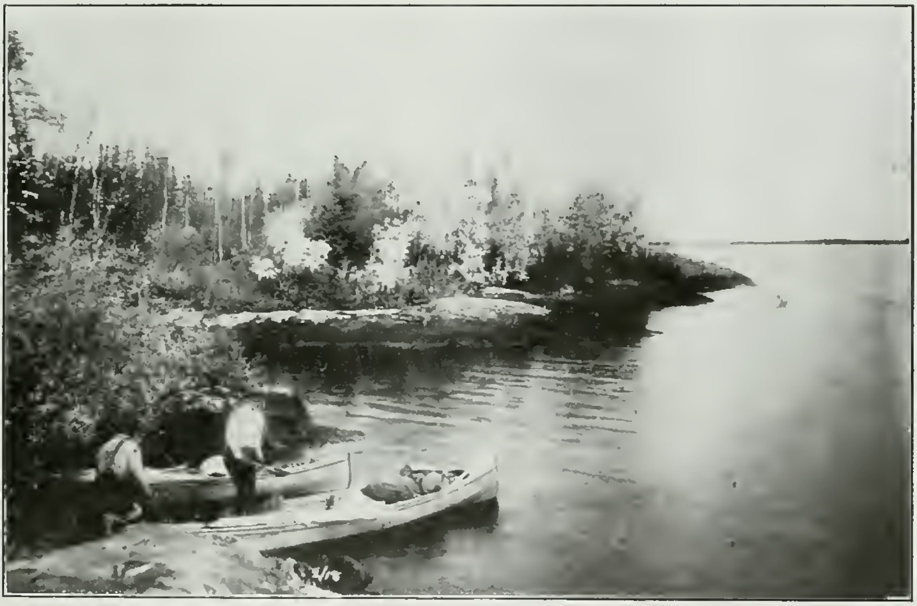


Photo by J. B. Tyrrell, Sept. 24, 1912.
Shore of Big island in Trout lake, showing the greenstone rock with two sets of glacial markings running respectively North 40° West, and South 40° West.

The following descriptions of specimens taken from two places at which we stopped will give a good general idea of the character of the whole.

Island in Windigo lake.—A very much altered rock with ophitic structure, consisting for the most part of fine laths of plagioclase, shreds of chlorite, and grains of epidote, calcite, and magnetite. Pyrite is also present in small amounts. The calcite seems to be present in the form of little vein-like fillings.

Point on Windigo lake.—A fairly coarse-grained rock consisting of needles of plagioclase (labradorite?) and green hornblende, the latter very largely altered to chlorite. Considerable epidote and ilmenite are also present, the latter altered in places to leucoxene. Pyrite is a rare constituent. This rock appears to come in the diorite class, but shows the ophitic structure very plainly.

Trout lake occupies a basin excavated in green Keewatin schists and diabases north of a prominent granite ridge which now forms its southern boundary, and the many islands which rise above the surface of the water are mostly rounded glaciated knolls of greenstone. The time at our disposal did not permit us to examine any of these, except such as lay directly on our course. However, the following descriptions of specimens collected from Big island and another island two miles to the southwest of it will give a clear idea of the character of the rock. In most places it shows the typical pillow structure characteristic of many of the Keewatin greenstones throughout northern Canada.

Big Island, Trout lake.—A very much altered rock of diabasic texture. It consists for the most part of laths of plagioclase with an ophitic arrangement, and green hornblende. The latter mineral has quite evidently been derived by a uralitization process from augite. The unaltered pyroxene still remains in several places, but is mostly altered at the edges to hornblende. Ilmenite and pyrite are two fairly prominent metallic constituents, the former being altered in a great many places to leucoxene. The hornblende is also altered in several places to chlorite. This rock seems to represent an intermediate type between the epidiorites and the true diorites, being probably closer to the diorite division. The ophitic structure of the original rock is still in evidence, proving that the rock was formerly a diabase.

Island 2 miles southwest of Big island, Trout lake.—A very much altered rock consisting chiefly of epidote, calcite, chlorite, and kaolinized material. Small quantities of magnetite and quartz are also to be found. This may best be described as an epidote rock, the alteration having gone so far that no conjecture can be made as to its original identity.

To the north of the greenstones, near the north shore of Trout lake, are a number of outcrops of a massive intrusive anorthosite, which is possibly of Keewatin age, though it may be newer. This rock has a coarse porphyritic and granitoid structure and forms a conspicuous feature on the shore. The following descriptions of thin sections which were examined under the microscope by Mr. Thomson will give a good idea of its general character.

Island, mouth of Fawn River.—A feldspar rock consisting chiefly of plagioclase (labradorite and bytownite), but containing considerable quantities of chlorite and epidote as well. Hornblende, magnetite, and limonite are also found in small quantities. It appears to be a typical anorthosite somewhat weathered.

Fort Island, Trout lake.—A feldspar rock consisting almost entirely of plagioclase, but containing some epidote as well as a little chlorite, magnetite, and limonite. It seems to be a typical anorthosite.

Island, 4 miles east of Fort island, Trout lake.—A feldspar rock consisting almost entirely of plagioclase (labradorite) and epidote. Considerable chlorite appears also, as well as a little magnetite and limonite. It appears to be a typical anorthosite, considerably weathered.

Northwest end Fort island, Trout lake.—This rock consists for the most part of plagioclase (labradorite), green hornblende, and magnetite. A good deal of the hornblende has altered to chlorite and epidote. Quartz and pyrite are rare constituents. It seems to be a typical diorite, slightly altered.

Palæozoic

Ordvician

In descending the Fawn branch of the Severn river, the last Archæan rocks seen in the bed of the stream are at a distance of about one hundred and sixty-five miles from the shore of Hudson Bay measured in a straight line, and from there northward for about one hundred miles, no hard rocks of any kind in place are to be seen. Then limestones of about the age of the Guelph formation in Ontario make their appearance. No older rocks of Ordovician or Silurian age were found on this river, but away to the northwest about two hundred miles distant, on a branch of the Hayes river called the Shamattawa river, there is a long exposure of limestone in the form of low cliffs extending for several miles beside the banks of the stream. The limestone is thin-bedded and lies in a horizontal attitude and is usually mottled, very much like that at East Selkirk in Manitoba. The total thickness exposed is about twenty-five or thirty feet.

From this exposure, and from the talus of broken fragments on the bank at the foot of the cliffs a number of fossils were collected, among which were the following:—

Columnaria rugosa, Billings;
Streptelasma corniculum, Hall;
Favosites aspera, d'Orbigny;
Tetradium fibratum, Safford;
Strophomena julia, ? Billings;
Rafinesquina lata, Whiteaves;
Rhynchotrema capax, Conrad;
Dinorthis pectinella, Emmons;
Maclurina manitobensis, Whiteaves, var. *acuta;*
Maclurea subovata, n. sp.
Trochonema umbilicatum, Hall;

Photo by J. B. Tyrrell, June 28, 1912.
Talus of Ordovician limestone on the north bank of the Shamattawa river.

Hormotoma sp.
Holopea sp.
Orthoceras sp.
Orthoceras lepidodendroides, n. sp.
Actinoceras bigsbyi, ? Stokes;
Actinoceras richardsoni, Stokes; var. magnum, n. var.;
Actinoceras sp.
Cyrtoceras manitobense, ? Whiteaves;
Poterioceras tyrrelli, n. sp.;
Ascoceras boreale, n. sp.;
Trochoceras insigne, Whiteaves;
Spyroceras meridionale, ? Whiteaves;
Illaenus americanus, Billings;

Professor W. A. Parks, University of Toronto, gives the following notes and descriptions of the species here enumerated:—

Corals:—

Columnaria rugosa, Billings.—One good specimen in a soft calcareo-argillaceous matrix.

Streptelasma corniculum, Hall.—Five incomplete specimens which are probably referable to this species as defined by Lambe.

Favosites aspera, d'Orbigny.—Two coralla, each about four inches in diameter. The corallites are of nearly equal size in the individual specimen, but in one example they average about 1.5 mm. and in the other 2.5 mm. in diameter. The tabulae are complete and closely set: in the coarser form they are about 1 mm. apart, and in the finer example, five occur in the space of 3 mm. The specimens do not reveal the slightest trace of septal spines or mural pores. In *F. aspera* the pores are situated at the angles of the corallites; unless these structures can be made out, the reference of the form to the present species is doubtful. It would seem that we are dealing with the same form referred to by Lambe in the following words. "Specimens of a *Favosites* have also been collected at East Selkirk and Lower Fort Garry, Manitoba, that are doubtfully referred to this species; they do not show the mural pores although otherwise the structure is well preserved. The rocks at this locality have been referred by Mr. Whiteaves to the Galena-Trenton, so that if through the medium of other specimens from these places the pores are found to be situated at the angles of the corallites, the downward extension of the range of *Favosites aspera* will be considerable."

Tetradium fibratum, Safford.—One specimen showing clearly the structure of the species.

Brachiopods:—

Strophomena cf. julia, Billings.—Four casts of a strophomenoid form which closely resembles Billings' species in the possession of widely spaced major striae radiating from the beak. Compare also *Leptaena unicostata*, Meek and Worthen.

Rafinesquina lata, Whiteaves.—A fragment of a single valve which is probably referable to this species.

Rhynchotrema capax, Conrad.—A single worn and partly decorticated valve of doubtful identification.

Dinorthis pectinella, Emmons.—Three decorticated specimens referable to this species or possibly to *D. subquadrata*, Hall.

Gastropods:—

Maclurina manitobensis, Whiteaves, var. *acuta*, var. nov.—One cast of the interior with a small portion of the shell adhering on the convex side and with nearly the whole of the test on the flat side preserved. The shell is 95 mm. in diameter and the height of the outer volution is 35 mm. In form, the specimen conforms closely to Whiteaves' description, but the characteristic lines of growth and surface ornamentation are wanting. The flat side is slightly depressed in the middle. The peripheral angle is acute and is accentuated by a slight depression just above the margin on the convex side.

Maclurea subovata, sp. nov.—One good cast of the interior and several fragments. The maximum diameter is 63 mm. and the height of the outer volution 33 mm. The form resembles *M. bigsbyi* but it differs in that the "flat" side of the outer volution is quite convex; the amount of the convexity being one-fifth the width of the whorl. This feature gives a subovate rather than a trapezoidal outline to the cross section.

Trochonema umbilicatum, Hall.—Seven specimens, all casts of the interiors.

Hormotoma, sp.—Two casts with a portion of the test indifferently preserved. Apical angle more acute than in *H. trentonensis*. This form must be compared with *H. arctica*, Ami, which is listed as a new species but without description in "The Cruise of the Neptune."

Holopea, sp. One cast of the interior of a large specimen, 40 mm. wide by 30 mm. high. The specimen must be compared with *H. borealis*, Ami, listed without description in "The Cruise of the Neptune."

Cephalopods:—

Orthoceras, sp. indet.—One badly preserved cast of the chamber of habitation. Cross section oval, diameter 21 by 17 mm. Siphuncle small, central.

Orthoceras lepidodendroides, sp. nov.—One cast of the interior, showing portions of 8 camerae. Cross section ovate, 60 mm. by 30 mm., but the form is probably crushed. The whole surface is marked by distinct blunt nodes arranged in a quincuncial manner which gives the cast the appearance of a *Lepidodendron*. Siphuncle not observed. The surface ornamentation is very characteristic and is sufficient for the identification of the species.

Actinoceras cf. bigsbyi, Stokes.—Two badly preserved specimens with large nummuloid siphuncles which agree in shape and spacing with this species. The siphuncle is marginal and occupies fully two-thirds of the air chambers.

Actinoceras richardsoni, Stokes, var. *magnum*, var. nov.—One cast of the interior with septa and siphuncle preserved. If the shell is round the diameter cannot be less than six inches and is probably greater. The siphuncular annulations are 25 mm. in diameter, evenly rounded, and occur to the number of 12 in a length of 205 mm. A large endosiphuncle is observable having a diameter of 14 mm. The siphuncle is eccentric in position. This form agrees fairly well with *A. richardsoni*, but differs in the larger size of the shell and in the relatively smaller siphuncle.

Actinoceras, sp. indet.—One badly preserved siphuncle embedded in matrix. The specimen undoubtedly represents a different species, as the siphuncular beads are expanded anteriorly and are as much as 23 mm. apart. The form represents a transition to the genus *Huronia*.

Cyrtoceras cf. manitobense, Whiteaves.—Three fragments which are doubtfully referred to this species. The general size of the forms, the spacing of the septa and the position of the siphuncle agree fairly well, but the curvature of the septa is much less pronounced.

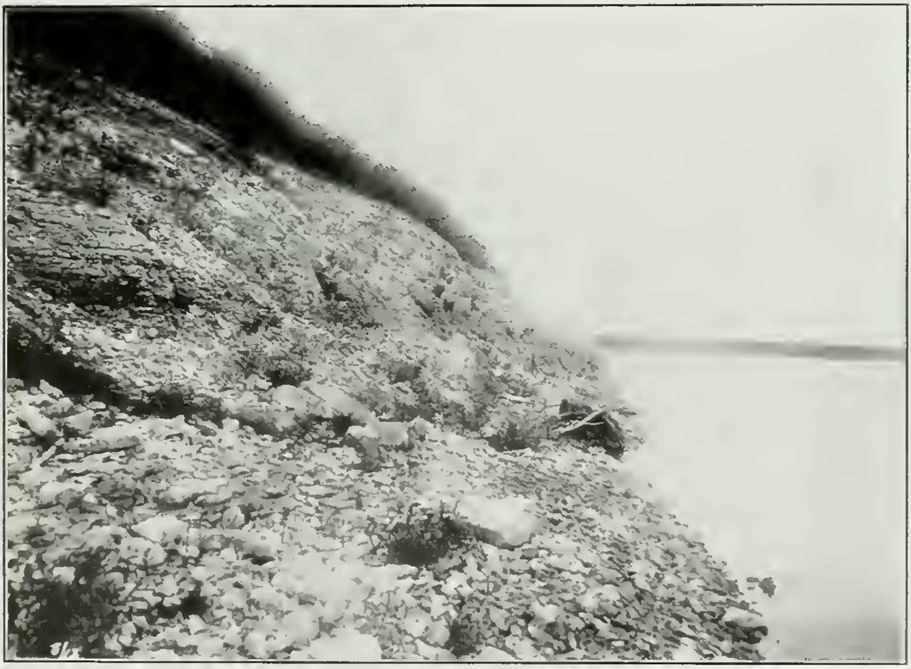


Photo by J. B. Tyrrell, Sept. 9, 1912.
Cliff of Silurian limestone at Assina rapid, Severn river.

Poterioceras tyrrelli, sp. nov.—Two well preserved casts of the interior, showing the characteristics of the chamber of habitation and of nine air chambers. The smaller and more perfect specimen gives the following measurements:

Maximum width at second septum, dorso-ventral, 48 mm.; lateral, 37 mm.
Width at ninth septum, dorso-ventral, 35 mm.; lateral, 30 mm.
Length of body chamber, 38 mm.
Diameter of orifice, dorso-ventral, 37 mm.; lateral, 22 mm.
Average spacing of septa, 3.5 mm.

The siphuncle is small and marginal in position. The body chamber contracts towards the mouth as shown by the above figures, but there is a sharp outward inflection of the shell at the aperture. On the posterior margin of the body chamber, the cast shows a ring of bead-like markings which occupy a space comparable with that of one air chamber. A photograph taken by Mr. Tyrrell of a specimen which he was unable to obtain shows this peculiar feature in a better manner than either of the specimens in hand.

Ascoceras boreale, sp. nov.—One cast of the interior; septa not preserved. This form differs in the curvature of the septal markings and in its general shape from *A. costulatum*, Whiteaves, and *A. canadense*. Billings.

Trochoceras insigne. Whiteaves.—A portion of a mould of the exterior. Whiteaves' only figure is of a cast of the interior, but there can be little doubt of the identification of the present example.

Spyroceras meridionale, ??? Whiteaves.—A small portion of a cast very doubtfully referred to this species.

TRILOBITES:—

Illaenus americanus, Billings.

These fossils would indicate that the rock is about the age of the top of the Trenton of Eastern Canada.

While there is no certainty that rocks of Trenton age occur as far eastward as the Severn river, it would seem not improbable that they may exist beneath the drift in the portion of the country where no exposures have been observed.

Silurian

As stated above, limestones which appear to be of about the age of the Guelph of eastern Canada, outcrop on the Fawn river at a distance of about sixty-five miles in a direct line southwestward from Hudson Bay, and continue to be exposed for a distance of fifty miles down the Fawn and Severn rivers to what is known as the Limestone rapids on the latter stream twenty-eight miles from the Bay. These rocks vary from thin-bedded limestones to thick-bedded Stromatoporoid dolomites, and while they most usually occur in the bed of the stream they often form low cliffs along its side. In the majority of exposures the limestone is horizontal, but at Limestone rapids of the Severn river it is undulating, a thin-bedded limestone rising over knolls of more massive dolomite.

Fossils are not abundaut in many places, and even where found are often difficult to extract from the rock in a sufficiently perfect condition for identification, but, nevertheless the following species were collected at the various rock exposures on the Severn and Fawn rivers, all of which are of about the same geological horizon. The collection was made without delaying the survey or rate of travel, and mostly during a day when we were obliged to remain in camp by a heavy storm of wind and rain.

Actinostroma tenuifilum. Parks;
Favosites gothlandica. Lamarck;
Favosites hisingeri, Milne-Edwards & Haime:
Halysites catenulatus, Linnaeus;
Pycnostylus guelphensis. Whiteaves;
Zaphrentis stokesi, Milne-Edwards & Haime;
Streptelasma sp.;
Petraia ? occidentalis. Whiteaves;
Acervularia austini. Salter;
Aphyllostylus gracilis, Whiteaves;
Tyrrellia severnensis n. sp.;
Fenestella subarctica. Whiteaves;
Rhynchospira lowi. Whiteaves;
Hormotoma patriciaense, n. sp.;
Hormotoma whiteavesii, Clarke and Ruedemann;
Pentamerus oblongus. Sowerby;
Trimerella ekwanensis. Whiteaves;
Glassia variabilis. Whiteaves;
Spirifer crispus, Hisinger;
Delthyris sulcata, Hisinger;
Reticularia septentrionalis. Whiteaves;
Gypidula, sp.;
Stropheodonta, sp.;
Camarotoechia ekwanensis. Whiteaves;
Plectambonites transversalis, Wahlenberg;

Meristina expansa, Whiteaves;
Bellerophon sp.;
Megalomphala robusta, Whiteaves;
Strophostylus filicinctus, Whiteaves;
Trepospira kokeni, Lindstrom;
Gyronema hudsonica, n. sp.;
Gyronema dowlingii, Whiteaves;
Gyronema speciosum, Whiteaves;
Coelocaulus macrospira, ? Hall;
Clathrospira sp.;
Eotomaria sp.;
Euomphalopterus tyrrelli, n. sp.;
Euomphalopterus sp.;
Euomphalopterus valeria, Billings;
Trochus, ? sp.
Lophospira, ? sp.;
Liospira, ? sp.;
Diaphorostoma perforatum, ? Whiteaves;
Pterinea, sp.;
Modiomorpha acuminata, n. sp.;
Orthoceras, sp.;
Gomphoceras, sp.;
Phragmoceras Whitneyi, n. sp.;
Phragmoceras lineolatum, Whiteaves;
Phragmoceras, sp.;
Cyrtoceras, n. sp.;
Barrandeoceras, ? sp.;
Endoceras hudsonicum, n. sp.;
Actinoceras hearsti, n. sp.;
Actinoceras, n. sp.;
Illaenus ioxus, Hall;
Encrinurus arcticus, ? Salter.

The short time at my disposal and the inability to carry a heavy load of specimens up the Fawn river and over the height of land to the head waters of the Albany and Winnipeg rivers so late in the season prevented me from collecting and bringing to Toronto as good and full a series of fossils from those Silurian limestones as I could have wished.

Professor Parks has supplied the following notes and descriptions, the localities from which I collected the fossils being at the same time carefully distinguished. Fuller descriptions, with figures, will appear in a later publication.

Silurian Fossils on Severn and Fawn Rivers

B.—Limestone Rapids, Severn River.

Stromatoporoids:—

Actinostroma tenuifilum, Parks.—Three specimens in which the structure is largely destroyed, but which are probably referable to this species.

Corals:—

Favosites gothlandica, Lamarck.

Favosites hisingeri, Milne-Edwards and Haime.

Pycnostylus guelphensis, Whiteaves.

Pycnostylus elegans, Whiteaves.—Some of the specimens referred to this species show certain differences which may demand the creation of a new species.

Zaphrentis stokesi, Milne-Edwards and Haime.

Aphyllostylus gracillus, Whiteaves.—One specimen in a poor state of preservation which is provisionally referred to this species.

Tyrrellia severnensis, gen. nov., sp. nov.—One specimen of a coral which does not seem to belong to any described genus. The corallites are single, cylindrical and elongated having a diameter of 5 mm. Septa numerous, reaching almost to the centre on the upper surface of each tabula, but not extending to the next tabula above except at the periphery. The septa therefore appear as a circle of radiating plates on each tabula, having the full height of the intertabular space at the periphery but diminishing to nothing at the centre. The tabulae are about 0.5 mm. apart; they are flat or slightly convex at the centre, but are sharply inflected downwards at their margins. No other endotheeal structures are apparent.

BRACHIOPODS:—

Rhynchospira lowi, Whiteaves.—One imperfect cast probably referable to this species.

GASTROPODS:—

Hormotoma patriciaense, sp. nov.—One cast showing three whorls. Total height 100 mm. Width of body whorl about 50 mm. Sutures deep. Whorls evenly convex. Apical angle about the same as in *H. winnipegense*, Whiteaves, but the present species is more elongate; for a given height of whorl, the width is not more than two-thirds that of *H. winnipegense*. The form should perhaps be referred to the genus *Fusispira*.

Bellerophon, sp. indet.—Four casts of a bellerophon which probably represent a new species but which are too imperfect to warrant description at present.

Megalomphala robusta, Whiteaves.—One imperfect cast agreeing fairly well with Whiteaves' figures of this species.

Strophostylus filicinctus, Whiteaves.—One cast probably referable to this species.

Trepospira cf. kokeni, Lindström.—Cast and mould of a small shell which is probably related to the above form described by Lindström from the Silurian of Gothland.

Gyronema or *Poleumita hudsonica*, sp. nov.—Several imperfect casts of a large specimen of more than three inches in diameter, also a portion of the body whorl of a smaller individual. The specimens differ from *G. speciosum*, Whiteaves, in having the revolving carinae more widely spaced on the upper than on the lower side of the whorl. The spire is apparently depressed so that the general form is comparable with that of certain examples of *Poleumita scamnata*, Clarke and Ruedemann.

Coelocaulus cf. macrospira, Hall.—Imperfect casts of a form which must be closely related to this species. Practically indeterminable.

Clathrospira, sp.—A large but broken cast very closely resembling *C. deiopea*, Billings, from the Guelph of Ontario.

Eotomaria, sp.—A single cast with the upper part of the spira lacking. Resembles *E. durhamensis*, Whiteaves, from the Guelph of Ontario.

Euomphalopterus tyrrelli, sp. nov.—Portions of the internal cast of a large form measuring fully eight inches in diameter. The outer whorl has a width of two inches: it is evenly rounded on the inner side, but the outer side is convex above and slightly concave below with a sharp carina at the inferior margin. The whorls decrease in diameter very slowly so that there must be about seven volutions in all. Lacking any portion of the shell, generic relationships are hard to determine. The shape of the whorls, the wide open umbilicus and the slightly ascending spire seem to suggest the genus *Euomphalopterus*.

Euomphalopterus, sp.—A single cast of the interior which resembles that figured by Billings as *Pleurotomaria elora*. The present form is smaller and, lacking any portion of the shell, gives no indication of the external features characteristic of Billings' species.

Trochus ?? sp. indet.—Two small casts of interiors resembling some of the forms described by Lindström as *Trochus* from the Silurian of Gothland.

Lophospira or *Coelocaulus*, sp. indet.—One imperfect mould of the exterior. Most of the whorls show a rounded outline, but there is some evidence that an acute alation was present. The form is probably related to species described as *Pleurotomaria valeria* by Billings or as *P. velaris* by Whiteaves.

Liospira ?? sp. indet.—Two casts of a small shell with a very depressed spire and with an acute edge on the body whorl. Resembles the Ordovician genera *Raphistoma* or *Raphistomina*.

Diaphorostoma cf. perforatum, Whiteaves. A broken cast of the apical portion of a shell which resembles Whiteaves' figure in its general contour.

PELECYPODS:—

Pterinea, sp. indet.—An imperfect cast with the wing broken off. Compare also *Ambonychia septentrionalis*, Whiteaves.

Modiomorpha acuminata, sp. nov.—Several specimens, some with the shell preserved, very pointed at the anterior end, length about 70 mm. These shells will admit of accurate description.

CEPHALOPODS:—

Orthoceras, sp.—Several specimens of an *Orthoceras* or possibly a slightly surved *Cyrtoceras*. Diameter posterior to the body chamber 35 mm. Siphuncle fairly large and slightly eccentric. This form probably represents a new species but it would be hazardous to describe it as such at present. The form is certainly not *O. ekwanense* of Whiteaves.

Phragmoceras whitneyi, sp. nov.—One cast of the body chamber of a very large form. The aperture is fully six inches across and the diameter of the body chamber at its posterior end is four inches. The cast shows a faint indication of a beaded ornamentation. The general shape of the body chamber is much like that of *P. lineolatum*, Whiteaves, but the much greater size seems to justify the establishing of a new species.

?? *Phragmoceras lineolatum*, Whiteaves.—One crushed and broken cast of the body chamber and two air chambers. The ovate outline and the size and position of the siphuncle correspond with Whiteaves' figures, but the ears of the body chamber are broken off so that certain identification is impossible.

Phragmoceras, sp.—Several fragments of the separate portion of a species of this genus with the septa varying from 3 mm. apart on the concave side to 7 mm. on the convex. It is impossible to state whether these fragments belong to the other species listed.

Cyrtoceras, sp. nov.—Cast showing 16 air chambers in a length of 40 mm. Slightly curved. Siphuncle small, eccentric, but not marginal. Resembles *C. orodes*, Billings, but it is less curved and the siphuncle has a different position.

??*Barrandeoceras*, sp. indet.—Portion of the body chamber of a coiled Cephalopod possibly referable to this genus. Section ovate, 24 by 28 mm. in diameter.

Endoceras hudsonicum, sp. nov.—Shell large, four inches or more in diameter. Septa strongly curved, about 7 mm. apart as measured on the surface. Siphuncle 35 mm. in diameter. Funnels reach just to the next septum apicad. No endosiphuncular structures apparent. Siphuncle 20 mm. from the margin of the presumably ventral side. Possibly should be ascribed to the genus *Nanno*.

Actinoceras hearsti, sp. nov.—Shell large, gently tapering. The specimen shows a diameter of about 4 inches. Siphuncle strongly nummuloid, large and marginal, with a central endosiphuncle, diameter 50 mm. Nummuloid beads oblique at about 15 degrees. Rings not evenly convex but greatest anteriorly. Siphuncle less than 5 mm. from the margin. This specimen is much larger than *A. keewatinense*, Whiteaves; it resembles *A. richardsoni* magnum in which the siphuncle is of about the same size but in which the septa are much closer together, and in which the nummuloid beads are of a more regular outline.

TRILOBITES:—

Illaenus (*Bumastus*) *cf. ioxus*, Hall.—Portion of a buckler which seems to correspond with this species.

C.—The ten-mile stretch above the Limestone Rapids, Severn River; slightly newer geologically than B.

CORALS:—

Halysites catenulatus, Linnaeus.
Streptelasma, sp. indet.

BRYOZOA:—

Fenestella subarctica, Whiteaves.

BRACHIOPODS:—

Pentamerus oblongus, Sowerby.
Trimerella ekwanensis, Whiteaves.
Glassia variabilis, Whiteaves.
Spirifer crispus, Hisinger.

Delthyris cf. sulcata, Hisinger.—Two casts are very doubtfully referred to this species.

Recticularia cf. septentrionalis, Whiteaves.—One cast of a small example of this species.

Gypidula sp.—Several specimens of casts of small Pentameroid shells requiring further investigation.

Stropheodonta, sp. indet.—Several small stropheodontoid casts impossible of identification.

GASTROPODS:—

Gyronema dowlingii, Whiteaves.

Gyronema speciosum, Whiteaves.—A small fragment doubtfully placed here.

Diaphorostoma perforatum, Whiteaves.—A crushed and broken body whorl possibly belonging to this species.

Bellerophon, sp. indet.—Apparently the same species as from the Limestone rapids.

CEPHALOPODS:—

Gomphoceras, sp. indet.—Two casts of the body chambers of small individuals of indeterminable species.

D.—Assina Rapids, Severn River.

Corals:—

Favosites hisingeri, Milne-Edwards and Haime.
Zaphrentis stokesi, Milne-Edwards and Haime.
Acervularia austini, Salter.

Brachiopods:—

Camarotoechia ekwanensis, Whiteaves.—One cast resembling this species. The specimen is somewhat less gibbous than the type.

Gastropods:—

Hormotoma whiteavesii, Clarke and Ruedemann.—Three casts of interiors indistinguishable from this species.

Euomphalopterus valeria, Billings.—One very perfect cast of the interior and one mould of the umbilical side. As far as can be judged from casts, these specimens belong to Billings' species.

Phragmoceras cf. whitneyi, sp. nov.—A fragment showing 14 air chambers. This septate portion might well accompany the body chamber herein described as *P. whitneyi*. There is no proof beyond the resemblance in size that the two portions represent the same species.

Actinoceras, sp. nov.—One siphuncular segment of a species evidently different from any other in the collection. The ring is about 55 mm. by 43 mm. with a very distinct endosiphuncle of 12 mm. in diameter. If the direction of the endosiphuncle represents the axis of the shell as it probably does, the siphuncular rings are inclined at a very high angle—considerably more than 45 degrees from the transverse position. The rings are therefore very asymmetric and appear to have been strictly marginal in position.

E.—Limestone Rapids, Fawn River.

Corals:—

Halysites catenulatus, Linnaeus.

?? *Petraia occidentalis*, Whiteaves.—A small form of Streptelasma or Petraia resembling this form externally. Requires microscopic examination.

Brachiopods:—

Rhynchospira lowi, Whiteaves.
Plectambonites transversalis, Wahlenberg.
Meristina expansa, Whiteaves.

Trilobites:—

Encrinurus cf. arcticus, Salter.—One badly preserved and partly exfoliated pygidium, possibly belonging to this species.

These fossils show that the rocks are similar in age to those found by Messrs. McInnis and Dowling on the Winisk and Equan rivers, and that they are approximately of the age of the Guelph limestones of Ontario or of the Middle Silurian of the ordinary stratigraphic series.

Pleistocene

Glacial and Post-Glacial

The hard rocks which have just been briefly described do not seem to have been covered by any sediments laid down between the end of the Silurian period and the beginning of Glacial times, or if such sediments were deposited on any parts of the country they have been completely removed and no trace of them is now to be seen.

The series of events which inaugurated the Glacial Period in this district would appear to have been somewhat as follows:—

From a centre lying to the west of the northern portion of Hudson Bay, somewhere in the vicinity of latitude 62, a glacier which, when I determined its existence in 1894, I called the Keewatin glacier, moved southwards and southeastwards far down across the basin of lake Winnipeg and an undetermined distance into the country east of lake Winnipeg. It brought with it clays, sands and fragments of rock from the western side of the basin of Hudson Bay and distributed them along its course.

After this Keewatin glacier began to shrink and to withdraw from the country which it had occupied for a long period of time, another great glacier formed on the higher level somewhere between Hudson Bay and Lake Superior and flowed northward, and doubtless also westward and southward, over the surrounding lower land. At the same time the basin of Hudson Bay itself was probably larger than it is at present, and was being filled by marine sedimentary deposits.

For this glacier, which has now been definitely recognized for the first time, I propose the name Patrician glacier, to distinguish it from the Keewatin glacier to the west and the Labradorean glacier to the east. The name proposed is derived from that of the immense new district in northern Ontario to which Her Royal Highness the Princess Patricia, daughter of His Royal Highness the Duke of Connaught, Governor-General of Canada, graciously permitted her name to be applied, for in it, somewhere between Trout Lake and the Albany River, this great glacier would appear to have had its centre and gathering ground.

Photo by J. B. Tyrrell, Oct. 4, 1912.
Point of glaciated rock at the south side of Weagamow lake.

As time went by this Patrician glacier gradually dwindled away and the Labradorean glacier assumed the most commanding size and position. It swept down from the highlands of Labrador, crossed the southern portion of the basin of Hudson Bay, and ascended to the watershed south of Hudson Bay, but whether it ever actually crossed this watershed or whether the more southern glaciers that have previously been regarded as portions of the Labradorean glacier have actually been parts of the older Patrician glacier or not, I am not as yet quite certain.

On its way the Labradorean glacier which, while crossing the basin of Hudson Bay, must have been buoyed up to a certain extent by water pressure, scooped up the marine sediments which had accumulated in the Bay and moved them southward over what is now land. This sediment so moved has now lost its sedimentary character, for it has been kneaded up with the shells and any other material contained in it into a homogeneous mass, with but few boulders, though those which it does contain are usually

Photo by J. B. Tyrrell, Sept. 30, 1912.
Surface of Kawagami moraine covered with burnt timber.

Photo by J. B. Tyrrell, Oct. 9, 1912.
Morainic hill of boulders overlying a gray gneiss on the second portage east of Geechika or Little Cedar lake.

striated. The Labradorean till or boulder clay is found to extend in a continuous sheet for about 150 miles back from Hudson Bay, while farther north there are also large, but probably discontinuous, areas covered with similar clay. It is possible that some of this till is now lying not very far from where it was first deposited as marine sediments, but nevertheless it has certainly all been moved and kneaded to some extent by the overriding glacier, for wherever the till had been completely removed the underlying rock was seen to have been strongly scored by this movement.

This clay would doubtless form a rich, fertile soil which could be easily worked by the agriculturist, for the amount of shelly material which is included in it makes it loose and friable.

Besides this vast expanse of till, the Labradorean glacier left a great series of moraines, with accompanying eskers and sand plains, stretched across the country. The last moraine formed on its retreat would appear to have been dropped into the waters of Hudson Bay.

After the Labradorean glacier had retired northward the sea occupied a position about four hundred feet higher than its present level, and marine sands and clays were deposited over the till, such marine deposits being seen on the tops of the cliffs overlooking the streams almost everywhere throughout the last hundred miles from Hudson Bay.

A detailed account of the beds of clay which occur along the course of the various streams followed on the way from Hudson Bay to the Grand Trunk Pacific railway is quite unnecessary here, as it is much better shown on the accompanying map, but nevertheless a few typical examples may be interesting.

On the lower portion of the Severn river till is first seen at a distance of about twenty miles from the mouth, where, in a cliff fifty feet high, the lower twenty-five feet are composed of dark brownish gray till with many striated boulders, among which are some of a hard red conglomerate, similar to the Athabasca sandstone and conglomerate which outcrops in the country northwestwards from Fort Churchill, and also many boulders of a fine-grained greenish-brown quartzite or graywacké which consists of quartz grains in a calcareous and argillaceous cement. Some roundish portions of this rock are much more calcareous than the rest, and these calcareous portions weather out fairly easily, making rounded white spots on the surface of an otherwise dark coloured boulder. On account of this peculiarity of weathering, these boulders are conspicuous and easily recognized, and as they are scattered throughout the till from the mouth of the Nelson river eastward at least to the Severn river, they must have been originally derived from an extensive area of quartzite. Up to the present, however, I have not been able to learn of anyone who has seen similar quartzite in place, and therefore the exact place of origin of these boulders is unknown. However, they are not very unlike the quartzite at Fort Churchill, and may possibly have been derived from an eastern extension of the Churchill quartzite. Besides these two rocks, boulders of granite, limestone, etc., which did not appear to have any specific characteristics were also common in the till.

Silurian Fossils on Nelson and Hayes Rivers

At the mouth of the Nelson river the till is very similar in character to that on the Severn river, but limestone pebbles are more numerous, and all appear to be of Silurian age. As proof of the age of these limestonese the following species of fossils were collected from loose fragments of limestone on the banks of the Nelson and Hayes rivers:

Favosites gothlandica.
Acervularia austini.
Conchidium decussatum.
Rafinesquina alternata.
Atrypa reticularis.
Phragmoceras parvum.

Cyrtoceras cordatum.
Actinoceras n. sp.
Isochilina grandis var. *latimarginata.*
Leperditia hisingeri.

Professor Parks supplies the following notes and descriptions of the above species:

F.—Drift at mouth of Nelson river:—

Favosites gothlandica, Lamarck.—A small and doubtful specimen.

Streptelasma or *Zaphrentis* sp. indet.

Acervularia austini, Salter.

Conchidium decussatum, Whiteaves.

?*Rafinesquina alternata*, Emmons.—Several *Strophomenoid* shells of which one strongly resembles this species. All are mere casts.

Phragmoceras cf. parvum, Hall and Whitfield.—Several casts of a species closely resembling this form.

Cyrtoceras cordatum, sp. nov.—One cast of the interior of the septate portion. Curvature, slight. Section, ovate, at the anterior end of the specimen, measuring 24 mm. dorso-ventrally and 19 mm. laterally. The venter is marked by a distinct cordate prominence, near which is situated the small elliptical siphuncle. The septa are about 2 mm. apart. This form suggests *C. cuneatum*, Whiteaves, but it is not co-specific, as the septa are 6 mm. apart in that species. The following remark by Dr. Whiteaves *re C. cuneatum* would apply equally well to this specimen. "It is evidently not a true *Cyrtoceras*, but a probably new generic type, which there is not yet sufficient material to define satisfactorily." In the same piece of rock is a species of *Lophospira*, not seen elsewhere in the collection.

H.—Drift on Hayes river, near York Factory.

Actinoceras sp. nov.—This form is nearer to *A. keewatinense*, Whiteaves, than any other in the collection. It is, however, less oblique and the rings are much narrower and closer together.

Isochilina grandis var. *latimarginata*, Jones.—Several casts closely resembling this form, but perhaps varying a little in the form of the tubercle.

Leperditia hisingeri, Schmidt.

K.—Drift on Hayes river.

Atrypa reticularis, Linnaeus.

Acervularia austini, Salter.—Several rolled pebbles of fine-grained corals or bryozoans which will require microscopic examination.

In addition to boulders of limestone, granite, diorite, etc., the till of this locality contains others of brownish quartzite with whitish eyes, similar to those mentioned above, greenish diabase, anorthosite, red Athabasca sandstone, Iron formation, and red porphyritic rocks similar to those which I found in 1893 occurring in the vicinity of Dubawnt Lake.

Mr. Ellis Thomson has furnished the following descriptions of microscopic sections of some of these boulders of red porphyry:—

No. 1.—A porphyritic rock with large phenocrysts of orthoclase and smaller ones of quartz in a medium-grained ground-mass of quartz, orthoclase and iron oxide. Ilmenite and apatite are rare constituents while the two alteration products, chlorite and leucoxene, are present in considerable quantities. The quartz crystals are for the most part fresh, but the feldspar phenocrysts are considerably weathered.

No. 2.—Another porphyritic rock with phenocrysts of plagioclase and orthoclase, as well as a very few quartz crystals, in a fine-grained ground-mass of needle-like feldspars (mostly plagioclase), quartz, chlorite, and hematite, the quartz showing granophyric structure. Magnetite and apatite are fairly prominent accessory constituents. The alteration products, chlorite, serpentine, and calcite, are also present in appreciable amounts. This rock probably corresponds most closely in composition to the micropegmatites or granophyres, similar to those found in the Sudbury district, although so greatly altered as to make this identification doubtful.

No. 3.—A highly weathered porphyritic rock with phenocrysts of plagioclase, orthoclase, and quartz. The ground-mass is very fine-grained, and is composed of quartz, feldspar, and iron oxide, the quartz showing granophyric structure. Magnetite, epidote, and chlorite are present in considerable quantities, while ilmenite, leucoxene, apatite, and fluorspar are more or less rare constituents.

The Northern Tills

On Hayes river the heavy bed of till extends up as far as Swampy lake, at an elevation of 500 feet above the sea. This is about the same elevation to which till extends as a regular uniform sheet on the Severn river farther east.

As we ascended the Severn river the underlying limestone was everywhere found to be covered by till similar to that above described. Also after leaving the Severn river and branching into its large eastern tributary which is known on the map as the Fawn river, though this name is unknown to the Indians of the vicinity, the banks continued to be formed of similar till. In many places there is a distinct horizontal dividing line in this till, and just beneath that line is often a well defined boulder pavement with the upper surfaecs of the boulders planed off and strongly grooved and striated in a direction north 10° west or south 10° east.

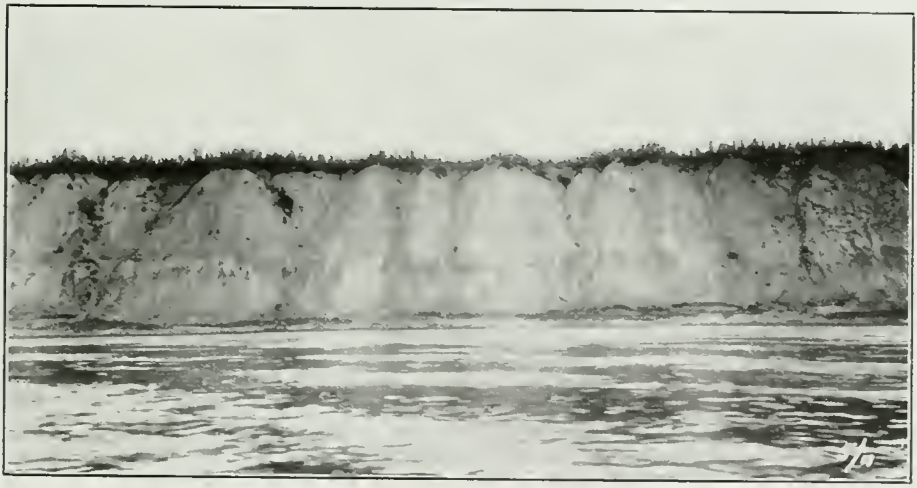


Photo by J. B Tyrrell, June 29, 1912.

Cliff showing the upper and lower till on the bank of the Shamattawa river.

On the Hayes river the upper and lower tills are often separated by a bed of stratified sand or gravel in which I searched in vain for fossils of any kind; on the Shamattawa river this dividing layer of sand was also often conspicuous, and in one place in it, as well as for a foot or two up into the till above the sand, moss and wood, partly altered to lignite, were recognized.

These banks of till continued uninterruptedly all the way up the Severn river to within a short distance of the lowest granite outcrop, when they gradually disappeared.

Through much of the distance from the mouth of the Severn up to the first exposure of granite rock the till was overlain by a varying thickness of stratified sands and clays carrying marine fossils. The surface of the till beneath these marine deposits is for the most part remarkably even and regular, no prominent hills or valleys being recognisable, except such as have been formed by later denudation and erosion. This regularity in the old surface contour of the till is a remarkable feature. It emphasizes the mental impression created by the nature and character of the till itself, namely, that it is simply a marine deposit nearly in place, which has everywhere lost its definite stratified character. Wherever it is seen to be underlain by rock there is evidence that it has been moved over that rock, for the rock is strongly grooved and polished. The boulders and pebbles which are contained in the till have been distinctly striated by movement over each other.

This vast area in the northern part of the district of Patricia, and in the adjoining portion of the Province of Manitoba, which is covered by till and marine sands and clays, has an average slope of about five feet to the mile northward towards Hudson Bay. This is abundantly sufficient to enable it to be effectively drained, and when drained it should prove to be a rich agricultural land, the southern portions of which would doubtless grow grains, such as are ordinarily grown in Manitoba and in the valley of the Saskatchewan, while the northern portions would furnish an abundant supply of grass and fodder for cattle and horses.

A short distance south of the mouth of Fawn river a ridge runs east and west roughly parallel to the shore of Hudson Bay. This ridge has not yet been explored, but judging from such information as was obtainable about it, it would appear to cross the Hayes river near the mouth of the Shamattawa, and thence to extend eastward as a series of lumpy hills, with intervening lakes, which constitute a famous hunting ground for some of the Indians at York Factory, and are known to them as the "Wachi" or Mountain. Thence it continues on, across the head waters of Goose river, Goose lake being one of the lakes by which it is broken, thence across the Severn river and away into the country towards the east. On looking at the map it may be seen that the lower course of the Fawn river and the long west to east course of the Winisk river are controlled by it. At first this ridge seemed to me to be simply an old shore line of Hudson Bay. While it is doubtless such a shore line, I am reasonably satisfied now that it follows an old water-laid moraine of the Labradorean glacier which was laid down in the bottom of Hudson Bay as the face of the glacier receded northwards. As it was laid down in the water it does not exhibit the same rough, irregular characters as many of the moraines hereafter to be described in the higher country farther south.

Photo by P. E. Hopkins, Sept. 17, 1912.

Lowest exposure of granite on Fawn river, showing two sets of glacial grooves and striae running respectively North 30° West and South 40° West.

Near the first exposure of granite rock on Fawn river, which is at an elevation of about six hundred feet above the present sea level, the surface of the country assumes a more stony character than it had farther north, and gravel ridges which are either eskers or beaches of extra-glacial lakes make their apperance. Thus we have here evidently reached a point where we are above and beyond the post-glacial marine sediments.

Clayey till continues to fill the bottoms of all the depressions and, in fact, to cover all the country except the more prominent rocky points.

Still farther south the rocky points become more prominent and rise to somewhat higher positions above the till. However, the clayey till is still the governing factor in the country southward to Trout lake and beyond it.

On the south side of Trout lake a high granite ridge rises as a conspicuous feature. Our course was up Mishwamágan river, a small stream which flows into the south side of the lake and breaks through and across this granite ridge in a series of heavy rapids. On the top of and on the southern slope of the granite ridge a large number of boulders, chiefly of granite, but some of greenstone, are scattered over the surface, and these doubtless represent a moraine which marked the front of the Labradorean ice sheet at one time in its southern advance. As this is the first strongly marked land moraine recognized on our journey southward this summer it will be convenient to designate it as the Trout lake moraine.

Photo by J. B. Tyrrell, Oct. 4, 1912.

Field of potatoes at Hudson Bay Company's trading post, Trout lake, District of Patricia, Ontario.

From the Trout lake moraine southward the country for a number of miles has comparatively little soil on it, the gray granite forming the surface for considerable areas. The fact that the forest was burned some years ago, and that a new growth has not yet started, tends to give the district a decidedly forbidding aspect. The presence of a great number of lakes between the rocky hills also clearly indicates that the supply of loose material left here on the retirement of the glacier was small, not being sufficient to fill even the minor depressions on the surface.

The ascent of Mishwamágan river was broken by many rapids, past which it was necessary to carry the canoes and outfit on trails which had been moderately well cut out by the Indians.

Near the source of this river is a lake called Kawagami lake which is surrounded by stony morainic hills, giving evidence of the deposition of a heavy moraine on the top of a secondary height of land. This moraine is one of the strongest seen during the summer and may be designated as the Kawagami moraine. To the south of this moraine lie Kwyuswagami and Makoop lakes, both extensive bodies of water lying in the midst of comparatively low country, the surface of which is chiefly composed of stony clay or till interspersed with ridges of sand and rounded gravel. Both these lakes, but chiefly the latter, are recognized by the Indians as being excellent fishing places. There is a small and permanent Indian village on the shore of Makoop lake. It is interesting to note that the best fishing lakes in the northern parts of Canada usually lie in country which is more or less thickly covered with clay and soil, and that the bottoms of these lakes are composed of mud. Whitefish, on which the natives mostly rely for food, favour a mud bottom, on which they can obtain an abundant supply of the lower forms of animal life on which they feed.

At the Indian village on Makoop lake potatoes seem to be regularly grown, and I was surprised to see a number of sharp-tailed grouse or Manitoba prairie chicken flying about.

From Makoop lake southward to Weagamow lake the country is covered by glacial clays and sands, though higher rocky hills rise as bare knolls above the general level.

Weagamow lake itself is an extensive though shallow sheet of water which lies in a basin of glacial clay. The glacial clay extends southward along the course which we followed up the Saskatchewawa river to Agutua lake, which lies at the foot of a number of high, sandy, esker-like hills. These hills of sand and gravel in their turn rest, in some cases at least, on the tops of stony morainic ridges.

The canoe route that we were following crossed a portage three and a half miles long over the top of one of these esker ridges from Agutua lake to Windigo lake, the latter of which is also surrounded by banks of sand and clay.

The great moraine which crosses the country near Agutua lake may be designated the Agutua moraine, and it is not improbable that the last advance of the Labradorean glacier terminated at it or in its vicinity.

From Windigo lake southward to the height of land the clay-covered areas become less and less frequent and extensive, and from the height of land southward around Cat lake and down Cat river to lake St. Joseph such deposits of drift as exist consist mostly of stony and sandy ridges, many of which have a definite esker-like character, and sand plains, doubtless formed by overwash near the face of the glacier.

From the above description of the drift-covered parts of the district of Patricia it will be seen that the Labradorean glacier, as it advanced southward up the slope from Hudson Bay, distributed a covering of till over large areas of country, and most of this till is not too stony to be of definite value for agricultural purposes. The extent of the land so covered is as yet quite unknown, but it will undoubtedly amount to tens of thousands of square miles.

Evidences of Glaciation

It is evident from what has been said above that the clay-covered areas are dependent for their existence, present position and condition on the glacial history of the country.

A short summation of this history was given at the beginning of this chapter, but it may be interesting to enumerate in somewhat greater detail a few of the observations on which that summary was founded.

At the Limestone rapids, twenty-eight miles above the mouth of the Severn river, there is a thickness of about thirty-five feet of till above the limestone, and the surface of the limestone, where it has not been exposed for any length of time, is beautifully scored in a direction south 55 degrees west by the movement of the Labradorean glacier over it. In some protected recesses, grooves and striae running north 5 degrees east were seen, caused by the northward movement of the Patrician glacier before the advance of the Labradorean glacier.

Farther up the Severn river the Labradorean glacier was evidently buoyed up or supported in some way so that it did not touch the underlying limestone for, throughout a distance of eight or ten miles, the rock is everywhere scored by grooves and striae pointing from north to north 10° west, the direction of the movement being often quite clearly defined. How the glacier was supported is not clear. It is hardly possible that the water could have been sufficiently deep to float it, so that it is likely that it slid over some of the till of the pre-existing glacier which had here remained frozen.

Near the mouth of the Fawn river, at a distance of sixty miles or thereabouts from Hudson Bay, the rock is again scored in a direction south 60° west by the Labradorean glacier, but on Fawn river, just where the limestone was last seen at the south end of a little cliff, the scorings of the Patrician glacier are again quite discernible bearing north 10° east.

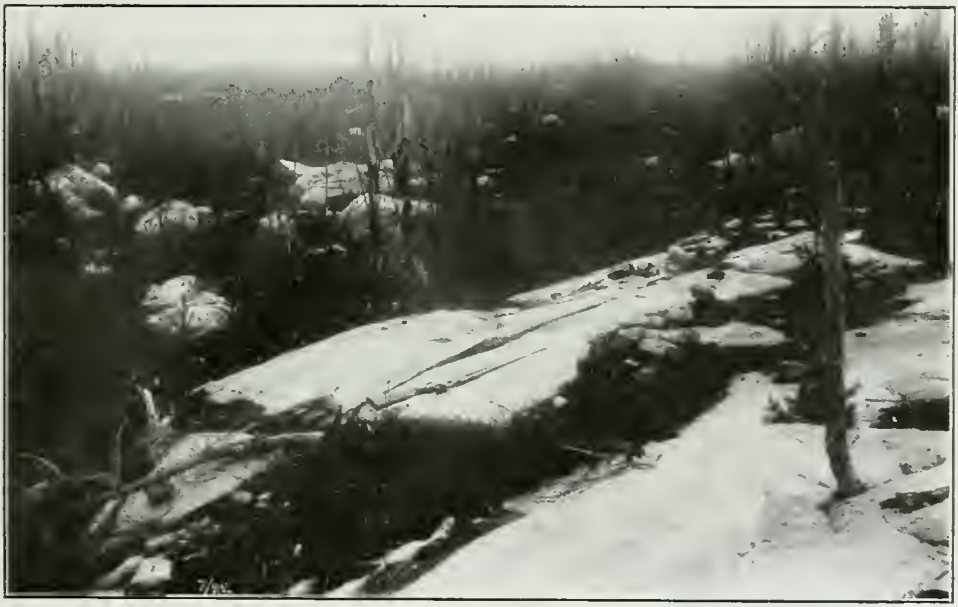


Photo by J. B. Tyrrell, Oct. 12, 1912.

Glaciated gneiss on the height of land portage between Severn and Cat rivers. The rifle points in the direction of the striation, which is South 80° West.

At the first granite rock seen on the Fawn river the scorings of the two glaciations are quite distinct. The scorings of the first one trend north 30° west, and show in protected recesses on a slightly irregular surface generally scored by the Labradorean glacier which moved south 40° west.

Thence southward all the way to Trout lake the two sets of scorings are quite distinct and recognizable, the later ones belonging to the Labradorean glacier, having however rather more definite courses than those of the earlier Patrician glacier, which swung slightly more to the west as it went farther and farther south.

In Trout lake itself the evidences of these two glaciations are beautifully clear and distinct. Many low rocky islands rise a few feet above the surface of the water, and it is at once noticeable that these islands differ from most of those seen in glaciated countries, inasmuch as they are rounded up from almost all sides, the only rough broken surfaces being to the west. On a closer examination it is found that they have at first been heavily planed and scored by a glacier moving north 25°—north 40° west, after which they have been again planed and grooved by a glacier moving south

40° west. The first planation was caused by the Patrician glacier, which would appear to have had a centre somewhere in the high country to the southeast of Trout lake, while the second was caused by the Labradorean glacier from the northeast.

South of Trout lake the evidences of the two distinct glaciations are often much more difficult to decipher, but there is no doubt that the Labradorean glacier extended as far south as the height of land where it formed the great Agutua moraine, and at the same time it also formed the high eskers which now rise as steep hills on the height of land and constitute the most conspicuous features in the whole region.

South of the height of land the presence of the Labradorean glacier is not by any means certain, for it is quite possible that all the scorings, moraines, eskers, and other glacial phenomena may have been caused by the westward or southwestward moving portions of the Patrician glacier which had its centre east of our line of travel on the height of land itself. The absence or rarity of scoring on the rocks of the height of land would appear to support this latter conclusion.

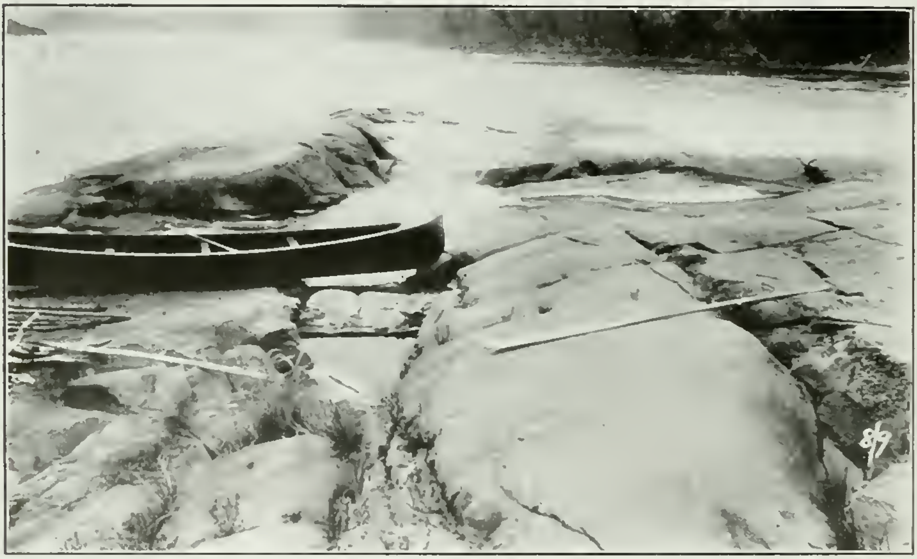


Photo by J. B. Tyrrell, June 24, 1912.

Grooves and striae running South 25° East, made by the Keewatin glacier on "The Rock" in Hayes river.

West of the Severn river, and between it and the Hayes river, very few records of glacial conditions have been made, but on the Hayes river itself I found evidence at "The Rock," which is the lowest exposure on the river, that there was a western-moving glacier which was probably the western extension of the Patrician glacier, subsequent to which there was a southeastern advance of the Keewatin glacier. The hill on the east side of Hayes river, which is known as "The Hill" or Chacutinaw, is an esker from one of these glaciers resting on top of a morainic ridge which extends away to the east, the conditions being very similar to those at the sandy hills at the head waters of the Severn river.

The following list of glacial striae observed during the summer will give any glacialist a clear idea of the conditions as we found them.

Glacial Striae on the Severn, Albany and Winnipeg Rivers

Sept.	5.	Severn R. Limestone Rapid	1st.	N. 5°-10° E.
Sept.	7	Severn R.	2nd.	S. 55° W.
Sept.	7.	Severn R. 2½ m. above Limestone Rpd.		N. 10° W.
Sept.	7.	Severn R. 3 m. above Limestone Rpd.		N. 10° W.
Sept.	7.	Severn R. 3½ m. above Limestone Rpd.		N.
Sept.	7.	Severn R. 3.6 m. above Limestone Rpd.		N. 10° W.
Sept.	7.	Severn R. 7.2 m. above Limestone Rpd.		N.
Sept.	9.	Severn R. Limestone cliff		S. 60° W.
Sept.	9.	Fawn R. Limestone cliff		S. 60° W.
Sept.	9.	Fawn R. Limestone cliff		N. 10° E.
Sept.	10.	Fawn R. Boulder pavement		N. 10°-20° W. or opp.
Sept.	17.	Fawn R. First rock	1st.	N. 30° W.
			2nd.	S. 40° W.
Sept.	17.	Fawn R. First Portage		S. 45° W.
Sept.	19.	Fawn R. Ninth Portage		S. 45° W.
Sept.	19.	Fawn R. Tenth Portage		S. 50° W.
Sept.	19.	Fawn R. Eleventh Portage		S. 50° W.
Sept.	20.	Fawn R. Twelfth Portage	1st.	N. 15° W.
			2nd.	S. 40° W.
Sept.	20.	Fawn R. 1 mile above Twelfth Portage	1st.	N. 15° W.
			2nd.	S. 40° W.
Sept.	20.	Fawn R. Thirteenth Portage	1st.	N. 20° W.
			2nd.	S. 40° W.
Sept.	20.	Fawn R. Between 14th and 15th Portages	1st.	N. 30° W.
			2nd.	S. 40° W.
Sept.	21.	Fawn R. Below Sixteenth Portage		S. 40° W.
Sept.	21.	Trout Lake Island, 4 miles w. of river	1st.	N. 25° W.
			2nd.	S. 35° W.
Sept.	21.	Trout Lake Island, 2 miles w.	1st.	N. 35° W.
			2nd.	S. 40° W.
Sept.	23.	Trout Lake, Hudson Bay Island	1st.	N. 30° W.
			2nd.	S. 40° W.
Sept.	24.	Trout Lake, Big Island	1st.	N. 40° W.
			2nd.	S. 40° W.
Sept.	24.	Island 2 m. s. of Big Island, Trout Lake	1st.	N. 40° W.
			2nd.	S. 40° W.
Sept.	27.	Mishwamagan River		S. 45° W.
Sept.	30.	Kwyuswagami		S. 80° W.
Sept.	30.	Makoop Lake		N. 65° W.
Sept.	30.	Makoop Lake		S. 35°-90° W.
Oct.	1.	Negigamo River		S. 20° W.
Oct.	2.	Ningitowa River		S. 55° W.
Oct.	2.	Ningitowa River, Ojiji Rapid		S. 60° W.
Oct.	2.	Ningitowa River, Wapekemung Rapid		S. 60° W.
Oct.	3.	Ningitowa River, Cheassin Lake		S. 25° W.
Oct.	4.	Ningitowa River, Kabadenegum Portage		S. 35° W.
Oct.	4.	Weagamow Lake		S. 55° W.
Oct.	4.	Saskatchewawa River		S. 55° W.
Oct.	5.	Saskatchewawa River		S. 55° W.
Oct.	8.	Windigo Lake, Island		S. 15° E.
Oct.	8.	Windigo Lake, Lunch		S. 5° E.
Oct.	8.	Windigo River, Chepowestik		S. 5° W.
Oct.	9.	Windigo River		S. 20° W.
Oct.	9.	Windigo River, 44th portage		S. 5° W.
Oct.	9.	Windigo River, 46th portage		S. 25° W.
Oct.	11.	Kishika River, 54th portage		S. 75° W.
Oct.	12.	Kishika River, S. 63rd portage		S. 85° W.
Oct.	12.	Wapasiniskak		N. 85° W.
Oct.	12.	Wapasiniskak		S. 85° W.
Oct.	13.	Cat River. 65th portage		S. 82° W.
Oct.	15.	Cat River. 70th portage		S. 55° W.
Oct.	15.	Cat River. Below 70th portage		S. 65° W.
Oct.	15.	Cat River. Smoothrock Lake, entrance		S. 60° W.
Oct.	15.	Cat River. Smoothrock Lake, Narrows		S. 60° W.
Oct.	15.	Cat River. Smoothrock Lake, Outlet	1st.	S. 10° E.
			2nd.	S. 25° W.
			3rd.	S. 55° W.
Oct.	16.	Cat River. 72nd portage		S. 52° W.

Oct. 17.	Cat River. Camp 16-17		S. 70° W.
Oct. 17.	Cat River. 75th portage		S. 65° W.
Oct. 17.	Cat River. 3 m. above Blackstone Lake		S. 47° W.
Oct. 18.	Lake St. Joseph		S. 55° W.
Oct. 18.	Lake St. Joseph		S. 45° W.
Oct. 19.	Root River		S. 40° W.
Oct. 21.	Lac Seul. Old H. B. Warehouse	1st	S. 65° W.
		2nd.	S. 50° W.
	Lac Seul. Lunch	1st.	S. 70° W.
		2nd.	S. 50° W.
Oct. 22.	Lac Seul. Lunch		S. 45° W.
Oct. 23.	River		S. 45° W.

Striae Observed on the Hayes River in Manitoba

Hayes River:—

June 24.	The Rock	1st.	S. 65° W.
		2nd.	S. 85° W.
		3rd.	S. 20° E.
June 24.	1 mile above The Rock		S. 25° W.
June 24.	Rocky Rapid. 4½ miles above "The Rock"	(grooves)	S. 20° W.
		(grooves)	S. 60° W.
		(grooves)	N. 75° W.
		(striae)	S. 40° W.
June 23.	2 miles below Nisotaniga Rapids		East or West.
June 19.	Oxford Lake		S. 50° W.
June 17.	Pot-hole point, Pine Lake		S. 50° W.
June 17.	Jackpine Rapid		S. 50° W.
June 14.	Near upper end Robinson portage		S. 45° W.
June 13.	Echimamish River		S. 42° W.
June 12.	Nelson River		S. 50° W.

Recent Deposits

On the maritime plain in the northern part of the district of Patricia the recent deposits are represented chiefly by clays and sands which have been laid down in the receding waters of Hudson Bay on top of the previously formed beds of glacial till. In most cases these deposits are rather thin, for the supply of sediment appears not to have been abundant.

On the lower portion of the Hayes river, however, the stratified clays and sands are very much thicker than usual, for there would appear to have been a deep embayment in the Post-glacial shore line at this point, into which a mud-laden stream probably emptied and deposited its load of mud and sand as it reached quiet water. The lower beds in this old embayment were probably deposited close to the receding face of the Labradorean glacier, for though they are of soft dark gray clay, they contain a considerable number of glaciated boulders, most of which are lying at a definite horizon near the top of a well defined clay bed, associated with marine shell in considerable abundance. The higher overlying beds are chiefly of fine or coarse sand and they also contain many well preserved marine shells.

The embayment or valley was not of very great width, for the west banks of the Hayes river to the west of it and the banks of the Machichi river to the east are both composed almost entirely of till.

The causes which led to the formation of this embayment or depression in an otherwise evenly till-covered country are not quite clear. It can hardly have been caused by subaerial erosion in Post-glacial times, for no other evidence of elevation of the land and subsequent subsidence and re-elevation such as would be necessary to permit of the erosion of such a valley were observed, and all other evidence at hand indicates clearly that there has been only one elevation of the land since the retirement of the Labradorean glacier from the country. It seems possible however, that this valley or embayment marked the western limit of the Labradorean glacier, and of the till formed under it, on Hudson Bay, and that the till on Nelson river, west of this old valley, was formed entirely either by the Keewatin or Patrician glacier or by both.

Subsequently, in Post-glacial times, this old valley of the Hayes river was filled with marine sediments to the level of the surrounding till-covered plain.

As a general rule the maritime plain, over which the marine sediments were spread in a sheet of varying thickness, extends inland from the shore of Hudson Bay to distances varying in different places from 75 to 150 miles. Across this plain a number of gravel ridges extend more or less continuously in a direction roughly parallel with the present shore of Hudson Bay, the more southern ones being constantly higher than the ones farther north. These ridges represent old shore lines of the Bay formed as the land rose very gradually to its present elevation and as the water receded to the shore which it now washes.

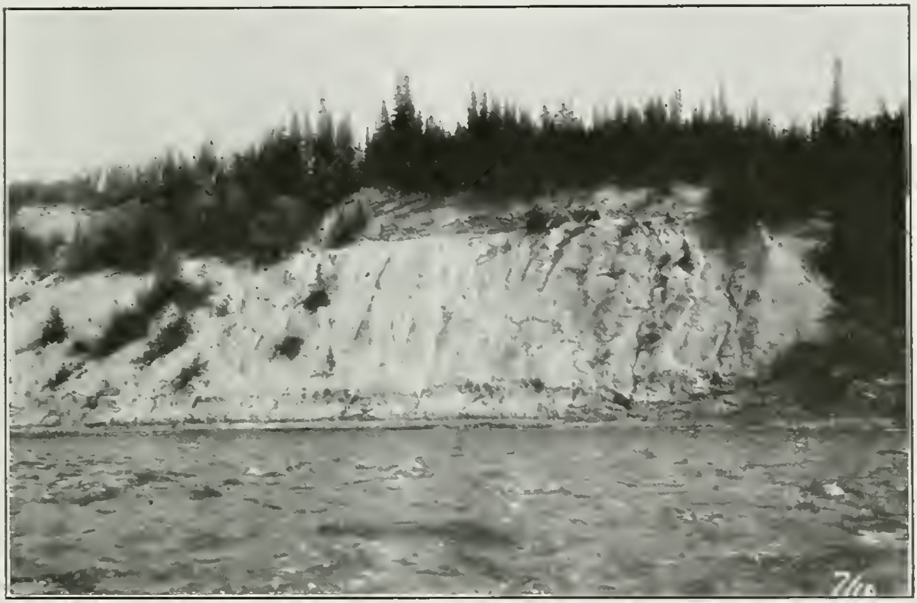


Photo by J. B. Tyrrell, June 25, 1912.

Cliff of till overlain by stratified marine sands on the east side of Hayes river.

Among the lowest of these old beaches one of the strongest may be seen on the west bank of Severn river 650 yards south of the trading post of the Hudson's Bay Company, with its crest 40 feet above high tide of Hudson Bay. On it a Mission church has been built, and behind the church an Indian trail starts northwestward and follows it for many miles as it forms a narrow dry belt through the adjoining swamp.

Farther up Fawn river, a branch of the Severn river, and near the mouth of Otter river, an extensive sand plain would appear to represent the highest of these old marine shore lines, where a delta had been formed at the mouth of some inflowing stream.

Farther inland, south of the maritime plain, most of the recent stratified deposits observed were formed immediately in front of either the Labradorean or the Patrician glacier, or they were directly connected with one or other of these two glaciers, but the areas covered by such extra-glacial deposits did not appear to be anywhere very extensive.

THE LAKE OF THE WOODS AND OTHER AREAS

By Arthur L. Parsons

Introduction

In accordance with instructions received from Mr. T. W. Gibson, Deputy Minister of Mines, the writer left Toronto on May 16, 1912, to do additional work in the vicinity of Lake of the Woods. In anticipation of the meeting of the 12th International Geological Congress to be held in Toronto in 1913, instructions were given to prepare a suitable excursion to show the essential features of the geology of the region. It was consequently necessary to review the work that had been done not only by the writer but by other geologists in that part of the lake within twenty-five miles of Kenora, so that the visiting geologists might have an opportunity of seeing typical examples of the larger divisions of the Keewatin as well as the less prominent but no less interesting Laurentian and Keweenawan rocks. In this work a few minor changes in the mapping of the Keewatin and Laurentian have been made and four Keweenawan dikes of quartz diabase have been traced. Most of the mines where work had been done in the preceding year were visited, and some prospects were examined, but most of the early part of the summer was primarily devoted to the preparation of the Congress excursion. The guide book for this excursion has been prepared and it is accompanied by a map showing the geology of the region covered by the proposed excursion.

On finishing this part of the work a geological section of the country between Kenora and the Manitoba border was made, which was later supplemented so as to give such a section as could be made on the train from Winnipeg, Manitoba, to Cartier, Ontario. The results of this work are embodied in the annotated time-table of the excursion of the International Geological Congress from Toronto to the Pacific Coast.

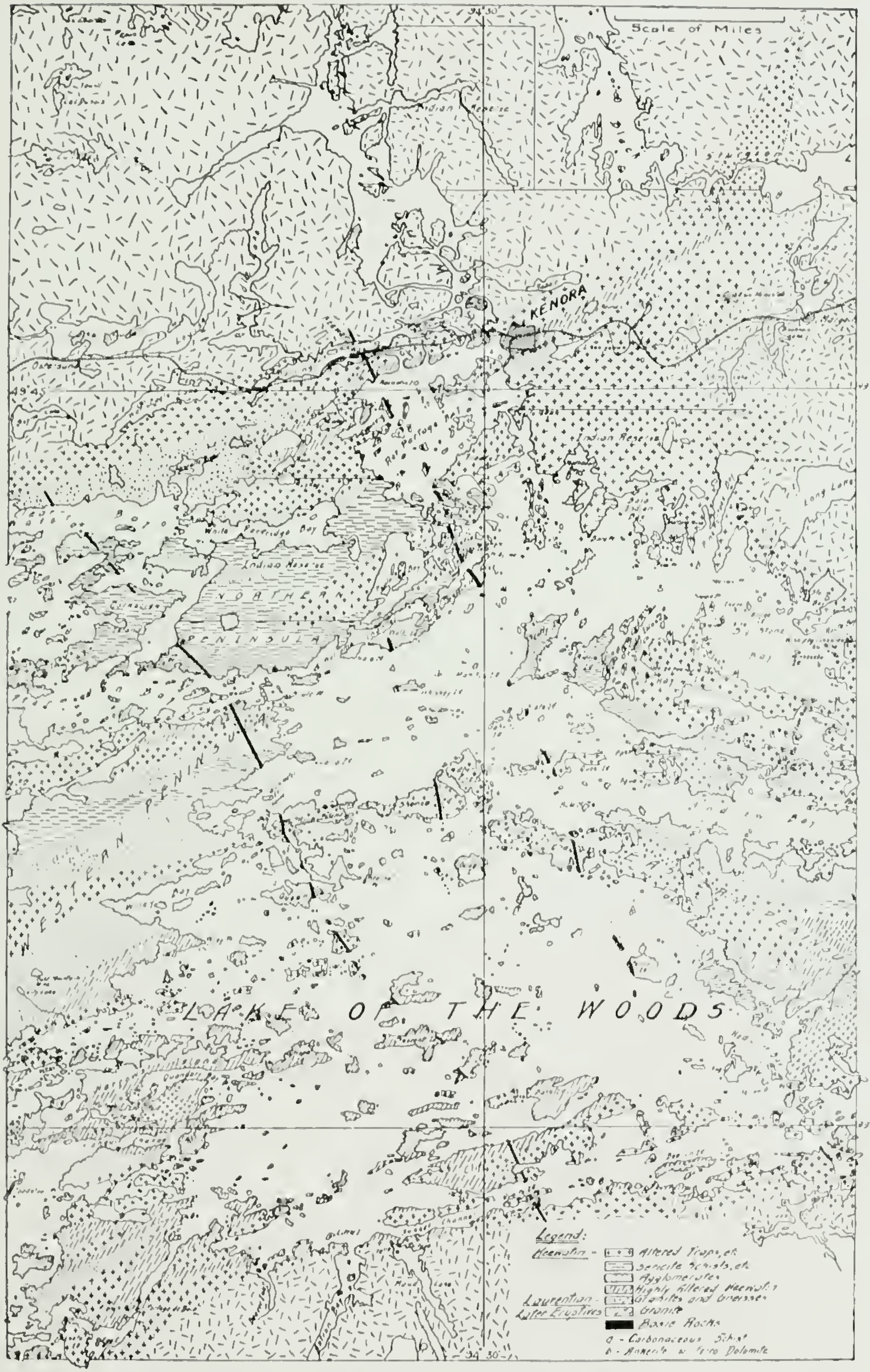
About the middle of August supplementary instructions were received to co-operate with Dr. A. E. Barlow in the preparation of excursions at Port Coldwell, Loon lake and Port Arthur, and the remainder of the field season was devoted to this work. Brief guides to the geological features near Loon lake and Port Arthur have been prepared by the writer, while the Port Coldwell guide was prepared by Dr. Barlow.

In carrying out the work of the season, Mr. C. W. Greenland, of Port Arthur, my assistant, rendered most efficient aid and was particularly valuable in the region around Port Arthur and Loon lake, with the geology of which he was very familiar, so that time and labour were saved in preparing the excursions at these places.

While in Lake of the Woods region, the party was further supplemented by a canoeman who also acted as cook, and in this capacity Mr. James Smith and Mr. Charles Flett, of Kenora, and Mr. Edward Wright, of Dryden, rendered efficient service.

Result of Summer's Work

The work of the season was necessarily limited to regions which have been the subject of careful study by other geologists, and in most cases it is only necessary to confirm their work. Several minor changes have, however, been noted which are indicated on the accompanying maps. The most important additions are the remarkable Keweenawan dikes, which have been traced entirely across the northern part of Lake of the Woods. In addition, a new granite area was found on the north side of Andrew bay and a smaller outcrop of granite at the south end of the Devil's Gap channel. Near Bare point an outcrop of sericite schist has been differentiated from the adjoining traps, and the boundaries of the clay slates, traps and granite near the Canadian Homestake (formerly the Scramble) mine have been materially revised. Three hitherto unmapped lakes on the north side of the Grande Presquile were found and a compass survey made. An examination of numerous granite outcrops gives



Northern part of Lake of the Woods, scale 4 miles to the inch.

strong grounds for correlating the Laurentian granites and those to which a later origin has heretofore been assigned. Evidence was also found near the Keweenawan dikes which strongly suggests, but does not definitely prove, that the rocks which are mapped as clay slates, etc., are merely highly altered phases of the more common types of Keewatin rocks.

Geology

The rocks of the Lake of the Woods region all belong to the pre-Cambrian and are divided into three general ages—Laurentian, Keewatin and Keweenawan (?). The earlier work by Dr. Robert Bell shows the Keewatin as Huronian, and the presence of the Keweenawan was not mapped. Later, Dr. A. C. Lawson showed that the rocks mapped by Dr. Bell as Huronian were different from any known Huronian rocks, and suggested the term Keewatin for these ancient traps and schists. He also found several outcrops of the Keweenawan diabase, and made a differentiation between some of the granites, assigning part to the Laurentian and others to a later period. The series as mapped by him are as follows:—

LAURENTIAN.
KEEWATIN.
    Hydromica schists, etc.
    Clay slate, etc.
    Agglomerates
    Hornblende schists and altered traps.
LATER GRANITES.
LATER DIABASE.

In addition, he indicated several outcrops of carbonaceous schist, dolomite and serpentine, the last of which may in some instances be found to be connected with the Keweenawan. His later work in the Rainy Lake region resulted in a further subdivision of the Keewatin as follows:—

Altered traps, etc.
Conglomerates
Altered quartz porphyries, etc.
Fragmental rocks, graywackés, volcanic tuffs, agglomerates
Soft glossy gray schists and slates
Gabbro
Serpentine

For purposes of mapping the writer has adopted the classification given by Dr. Lawson in the map of Lake of the Woods.

Laurentian and Later (?) Granites

In addition to the enormous areas of Keewatin rocks in the Lake of the Woods region are great masses of granite and gneiss which have been referred to the Laurentian. This term has been used by some in a rather loose sense to indicate a granite gneissic rock, without any attempt to define the geologic age to which it might belong, but by others more definite age has been assigned to these rocks. In his work on Lake of the Woods, Dr. A. C. Lawson made a distinction between some of the granites, referring part to the Laurentian and others to a later date. The committee on pre-Cambrian nomenclature for the Lake Superior region has recommended that those granitic masses which protrude through the Keewatin and antedate the Huronian, should be called Laurentian, but does not restrict the term to such masses, though when the name is used for later granites an explanatory term should be added.

In the Lake of the Woods region it is well nigh impossible to determine the exact age of these masses, because no rocks are known except the granites between the Keewatin and Keweenawan. It is possible that some of the rocks which are now looked upon as Keewatin may at some time be found to be Huronian, but so far as our present knowledge goes we can merely say that most of the granites are post-Keewatin and pre-Keweenawan, and the writer would adopt for all of the granite that he has seen, with the possible exceptions of the Log bay and Regina bay masses, the term Laurentian. In apparent contradiction to this view, those masses which have been classed as later granite by Dr. Lawson are indicated on the maps accompanying this report as possible later granite. In this way the smaller detached areas which may be of different age from the large masses are kept separate.

It may be said of the Laurentian masses that they are by no means simple, and very frequently as many as four distinct generations of rock may be seen in one small outcrop. This condition is usually near the contact with the Keewatin rocks, and a common phase shows inclusions of highly altered Keewatin in Laurentian gneiss with dikes of granite and pegmatite cutting the gneiss. This is well shown in a cut on the Canadian Pacific railway at a point about 18 miles west of Kenora.

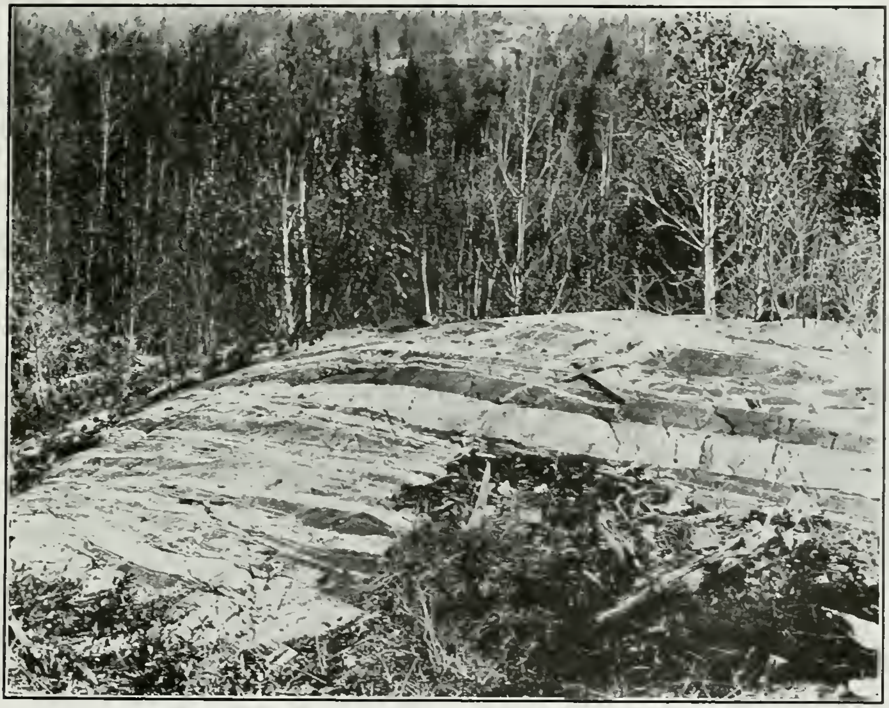


Fig. 1.—Contact breccia between granite and Keewatin schists, Sultana mine.

In comparing the outcrops of the Laurentian with the so-called later granite, it is found that where the contact relations are shown the accompanying phenomena are apparently the same. Usually the granite appears as a rounded boss or series of bosses protruding through the Keewatin. The summit of the boss has generally been denuded of all traces of Keewatin rock, but lower down the contact is marked by a contact breccia, which varies in its appearance as a result of the differences in the adjoining rock. In some cases the breccia resembles a banded gneiss. This is due to schistosity in the adjoining Keewatin rock which permitted the molten granite to force its way between the planes of schistosity. An excellent example of this type of breccia from Sultana island is shown in the accompanying illustration (fig. 1).

The other type of contact breccia results from the fracturing of massive Keewatin rock and is more common than the banded type. It is particularly well developed on the west side of Bottle bay, where the so-called later granite is exposed. It is also well developed on the north shore of Andrew bay, where a similar granite occurs. Much of the Laurentian granite along the Canadian Pacific railway near Kenora also shows this type of breccia (fig. 2).

The bosses of granite are usually dome shaped and this form is ordinarily attributed to glaciation. This view is, however, only partially correct. Near the north side of Bottle bay the bosses show traces of the contact breccia over the entire surface, while between the protruding masses the typical Keewatin traps and schist are to be seen. Evidently the dome-like shape of the granite mass at this point is due to the form originally assumed by the cooling mass of granite, so that the glaciation has only removed the softer overlying rock and the *roches moutonnées* are only indirectly the result of glaciation. On the west side of Bottle bay all possible stages of the removal of the overlying material may be seen. Here the Keewatin rock may be seen arched above granitic masses. In some cases the Keewatin is highly altered and re-crystallized and forms a dark coating over immense domes which are presumably granite, though this can only be inferred from the similarity of the topography to the granite domes which have been denuded of their covering. Other bosses show the granite protruding at the summit and the contact breccia grading into the unbroken Keewatin near the base. The same phenomenon may be seen on the Grande Presquile at the contact of the Laurentian and Keewatin. This great peninsula consists of almost innumerable bosses of granite which have to a large extent been denuded of any covering of Keewatin rock, but near the contact with the Keewatin the same type of contact breccia is developed as is seen in Bottle bay.

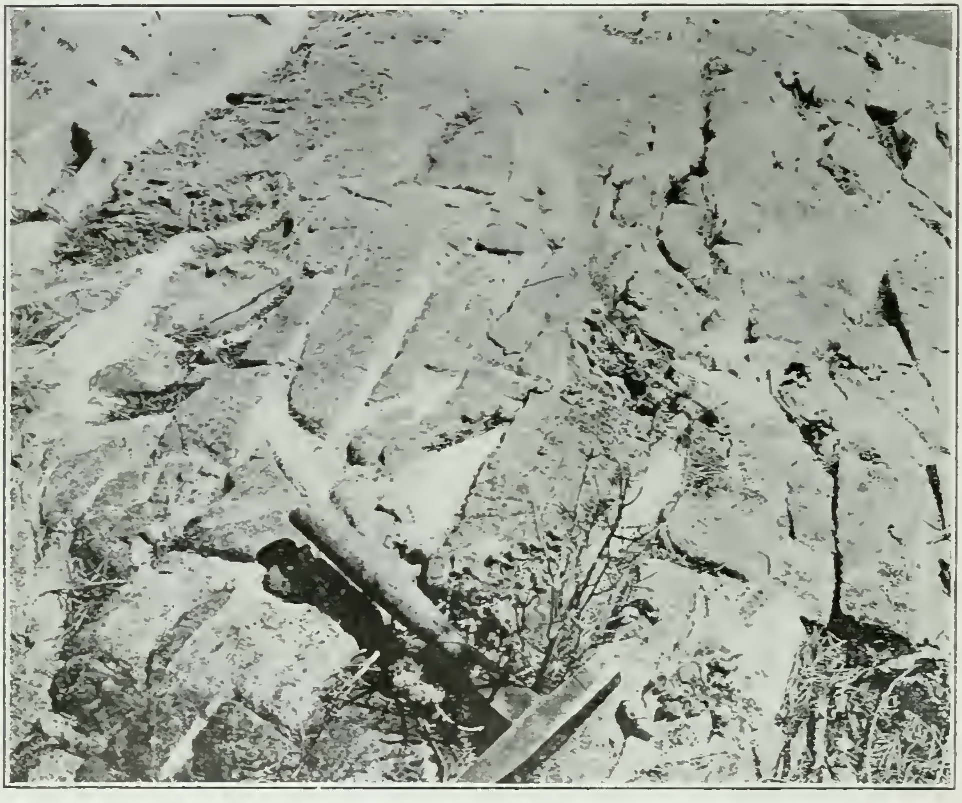
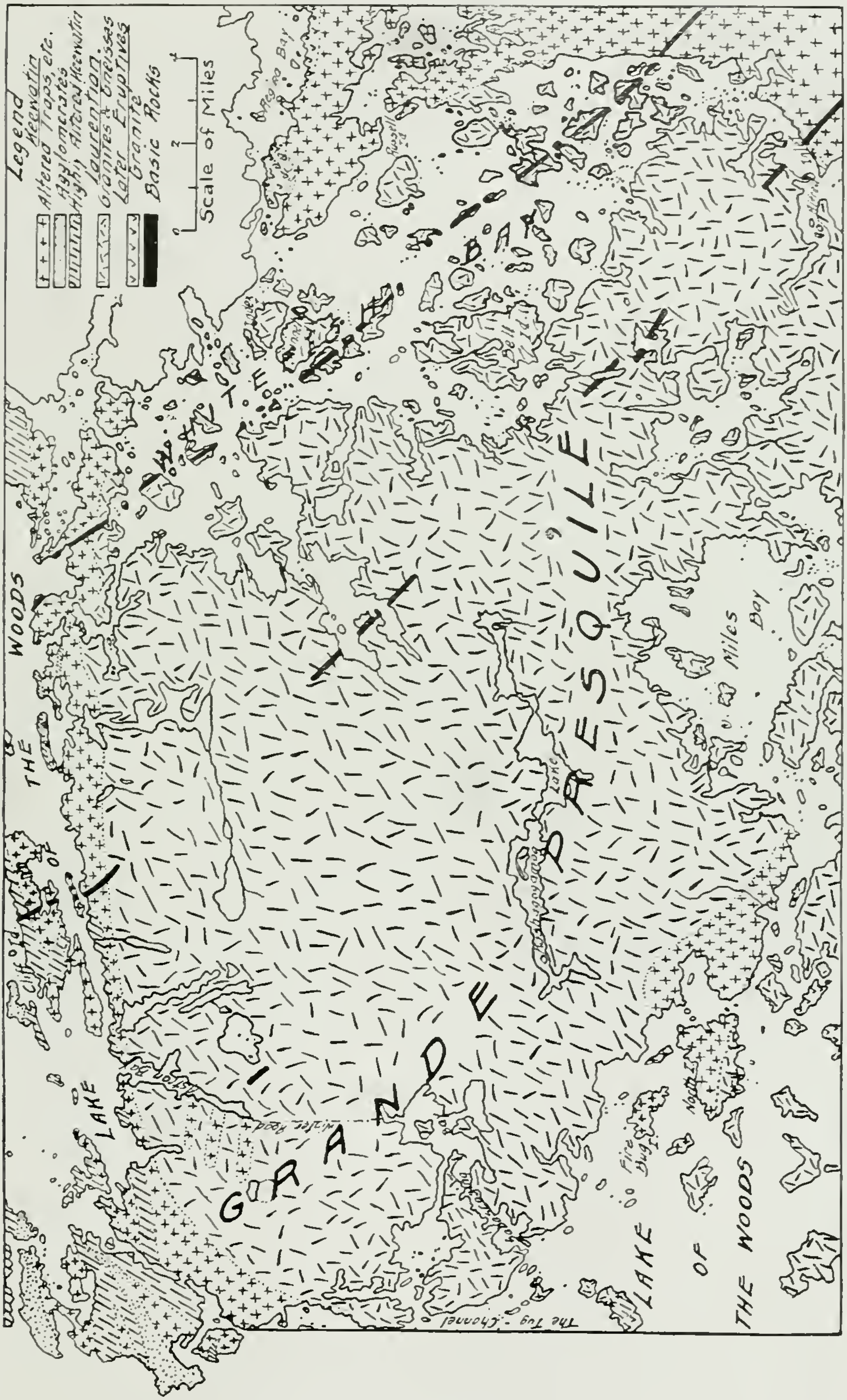


Fig. 2.—Breccia, Berry lake.



Grande Presqu'ile, Lake of the Woods.

Information was secured which tends to group part of the so-called later granite with the Laurentian. A small outcrop on the east side of Micrometer island is cut by one of the dikes of later (Keweenawan) diabase at the water's edge. Most of the dike has been eroded, so that the relations might easily be overlooked. The contact was found in tracing the dike which crosses Ptarmigan bay, and the nature of the contact is shown by the accompanying photograph of a thin section of the rock (fig. 3). The finding of this intrusion of diabase forces us to the conclusion that this particular granite is of the same age as the granites on the Grande Presquile, and that both are older than the Keweenawan. In like manner the granites on Darlington bay and Whitefish bay may be correlated, as they are both cut by the Thomson island dike. So far as our information goes the pre-Keweenawan age can only be shown for one of the outcrops of granite that has hitherto been classed as a later granite, but it can hardly be doubted that the granite on Crow Rock island is of the same age as that on Micrometer island; and if this is granted the granite on Shammis, Mather and Allie islands must be brought into the same age. In this way this granite area is presumably correlated with the Laurentian, and it is difficult to conceive of a different origin for the other granite areas occupying an intermediate position between the Micrometer island exposure and the outcrops on Darlington bay or Whitefish bay.

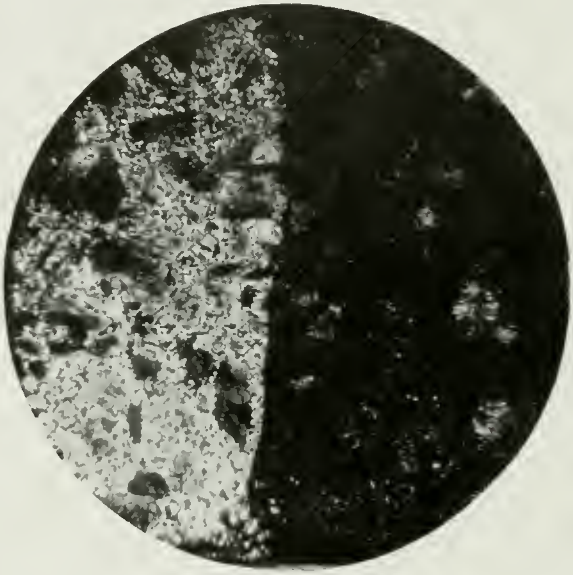


Fig. 3.—Contact of granite and Keweenawan (?) trap, Micrometer island, Lake of the Woods.

This correlation, however, still leaves the exact position of these granite masses in doubt, as no known Huronian rocks are present to aid in the determination of the age.

A series of granite domes which has hitherto been unmapped was discovered on the north shore of Andrew bay. The surface has been burned over in recent years so that their character could be easily observed. The shore is bordered by Keewatin schists of various types and in various stages of alteration. Through these schists several domes of granite rise to a height of 60 to 100 feet. The granite exhibits the typical contact breccia of fragments of highly altered Keewatin and contains a profusion of small quartz veins.

Clay Slates

This series, which consists principally of highly altered Keewatin rocks, is found most abundantly in close proximity to the great granite areas of the region. While some of the outcrops are probably altered slates, much of the material is metamorphosed igneous rock, which has been more or less re-crystallized. The rocks are mostly hornblende and biotite schists, which contain a greater or less quantity of garnet, epidote, magnetite and pyrrhotite in addition to quartz and plagioclase. Metamorphism resulting in similar rocks is found in the sericite schists which are cut by the dikes of later (Keweenawan) diabase, though in the latter case the extent of the metamorphism is limited to a few feet. Considerable diversity of opinion has been expressed as to the desirability of making a distinct division of the Keewatin to include this series. By some the series is looked upon as principally composed of altered sediments. The Committee on pre-Cambrian nomenclature in the Lake Superior region look upon them as highly altered phases of the Keewatin traps and schists. To the writer, this latter seems to be the true explanation for the greater part of the rocks of this series, but in some cases it would appear that sediments are present.[1] The explanation of the relations of these rocks can apparently be worked out only by comparing them with the other Keewatin rocks which have been altered by igneous intrusion.

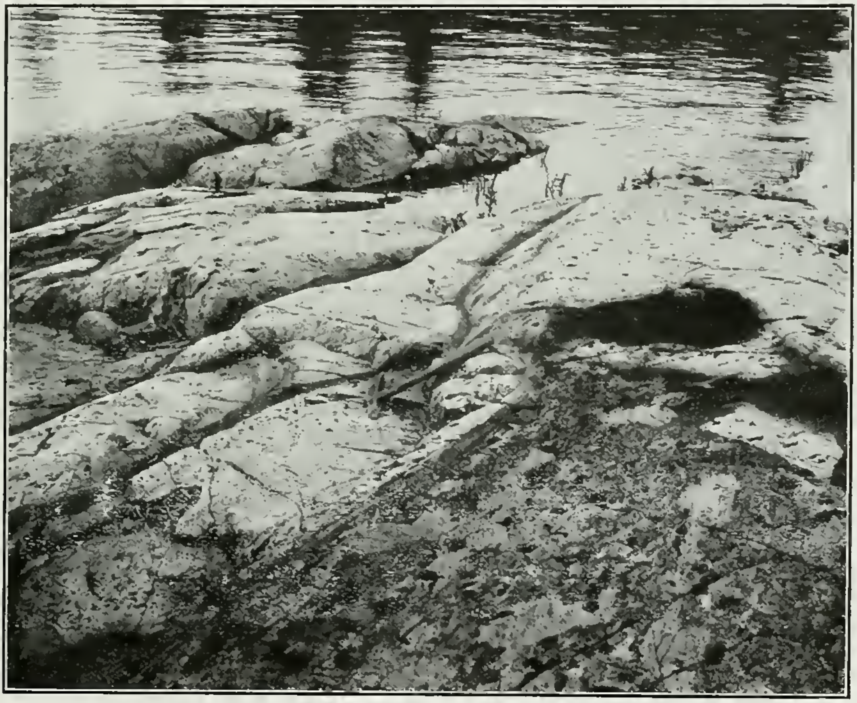


Fig. 4.—Ellipsoidal trap, Ash bay, Lake of the Woods.

In the alteration of the common ellipsoidal trap of the Keewatin large quantities of ankerite or ferro-dolomite have been formed, and by a movement in the rock or by pressure schistosity is induced. The schists are of several types, but are all more or less micaceous, chloritic or hornblendic. From the more acid traps sericite schist, containing a considerable percentage of ankerite, is formed. From the more basic traps chlorite and hornblende schists result. With the other minerals in these schists crushed feldspar and secondary quartz are almost universally present. Even in the traps which are apparently only slightly altered, the interstices between the ellipsoids are filled with ankerite, quartz and some hornblende and epidote. The schists resulting from the alteration of the traps are cut by Keweenawan dikes in several places. On Slate island the schists are metamorphosed to a distance of about 20 to 30 feet from a dike, and in place of the sericite and chlorite schist with abundant carbonate, we find a schist characterized by hornblende and epidote. In addition to these minerals, magnetite and hematite occur in small quantities near the contact of the same dike with the schists on Thomson island. It will thus be seen that the common minerals in the clay slate series, with the exception of garnet, are represented in the schists that result from the metamorphism of the ordinary Keewatin schists.

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[1] Bur. Mines, Vol. XXI., Pt. I., p. 202.

Agglomerates

Under this title are grouped fragmental rocks of extremely varied texture and origin. In some cases volcanic ash beds may be represented, in other instances the term is used to include friction breccias, while a considerable number of the exposures are volcanic breccias.

The first mentioned type has not been definitely identified by the writer, but the friction breccia type is quite common and is well shown on the unnamed islands between Queer island and Mather island. The rock is usually light coloured, and the interstitial material between the angular fragments is generally schistose and characterized by the presence of sericite. It is, in fact, an intermediate stage in the formation of the sericite schists from the lighter coloured Keewatin traps.

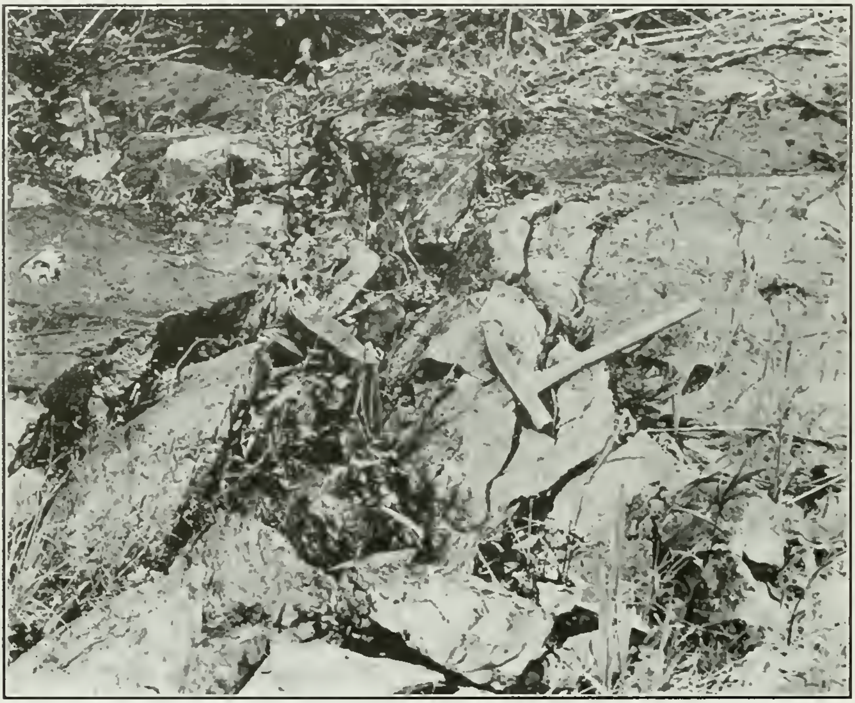

Fig. 5.—Ellipsoidal trap on right, breccia on left, Ash bay, Lake of the woods.

The volcanic breccia type of agglomerate is found well exposed near the old saw mill in Kenora and in Ash bay. The general character of this rock is illustrated in a former report,[2] which shows the rock at Kenora. The derivation of this rock from the ellipsoidal trap is not shown at this place, and a different origin was suggested by the writer, but in Ash bay the ellipsoidal trap is found exceptionally well developed (fig. 4). This rock is broken by a dark trap, which contains fragments of the lighter coloured rock, as shown somewhat imperfectly in the accompanying illustrations (figs. 5, 6, 7), the first of which shows the somewhat shattered ellipsoidal trap under the hammer and the dark trap with the fragments of the former rock. The second illustration overlaps the first and shows a more agglomeratic development. The third illustration overlaps the second and shows the darker trap with very few inclusions of the lighter trap. A more extensive development of this type of agglomerate in Ash bay (fig. 8) is almost identical with that in Kenora.

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[2] Bur. Mines, Vol XXI., Pt. I., pp. 170, 171 and 182.

Altered Traps, Hornblende Schists and Chlorite Schists

For purposes of mapping it is convenient to group these rocks together, and in general it may be said that the hornblende and chlorite schists represent an alteration of the ancient Keewatin traps. It must also be stated, however, that no close line of demarcation can be drawn between this series on the one hand, and the agglomerates, sericite schists, and clay slates on the other; but between the more characteristic phases there is an easily recognizable distinction which permits an approximate determination of the bonndaries of the principal types of rock. In general it may be said that the ancient traps are diorites, in which is developed a well defined ellipsoidal or pillow structure. In material which has suffered little alteration these ellipsoids are generally characterized by a light-coloured interior and a narrow band of darker rock on the outside which appears to be a basic segregation, though both portions may be classed as diorite. In the interstices between these ellipsoids is a filling of ankerite or ferro-dolomite with quartz and in some cases epidote and hornblende. Usually in weathered specimens this interstitial material has been removed. The ellipsoidal structure is a very persistent characteristic of these older traps, and it can be traced with a little care in the chlorite, hornblende, and sericite schists, which result from this alteration. So persistent is this characteristic of the traps that it may be said to be almost universal for the original rock and the slightly altered phases. Particularly fine examples of this structure may be seen, however, in the Devil's Gap passage, the west side of Big Stone bay, and on the east side of Ash bay.

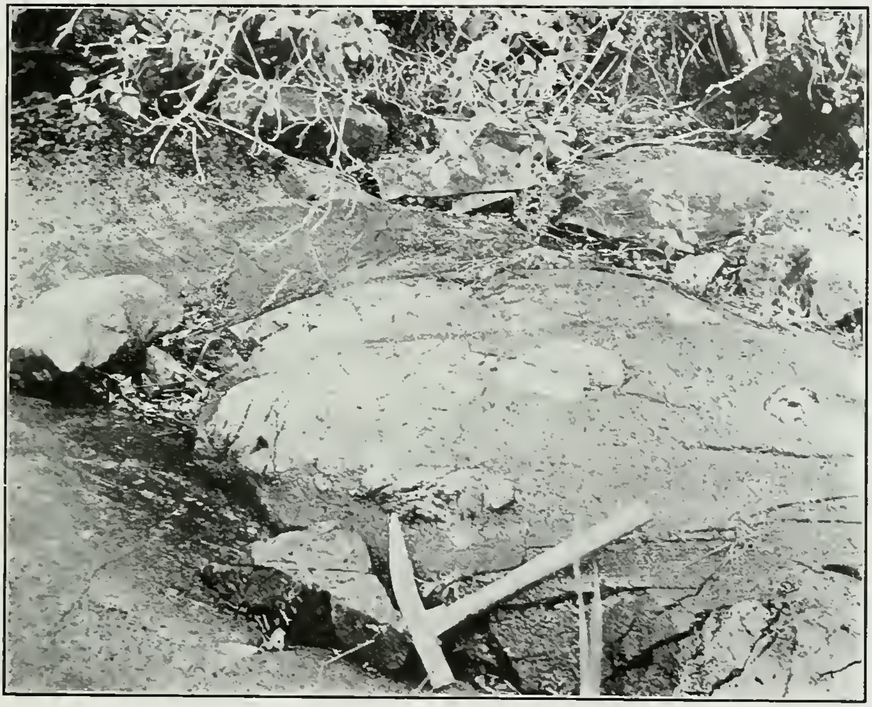

Fig. 6.—Igneous breccia, Ash bay, Lake of the Woods.

In the alteration of these older traps two general types of rock result, depending largely upon the amount of hornblende and augite in the original rock. In case hornblende and augite are abundant in the original material, the resulting alteration product is chlorite or hornblende schist, with an appreciable percentage of calcite and ankerite. In case there is little augite or hornblende the resulting rock is sericite schist, with calcite and ankerite. In the latter case a brecciated transition stage is common, which gives rise to large areas of agglomerate, but this stage is not prominent in the formation of the chlorite schists. In connection with these older traps it may be said that a second type of trap has been recognized, which has been referred to by Dr. A. C. Lawson as the "paste of the agglomerate," which is apparently of an intrusive nature, but appears to belong with the Keewatin. This rock is dark in colour and alters uniformly to chlorite and hornblende schists. The extent of this intrusive material is unknown, and it has been positively differentiated in only one place by the writer. The locality where it has been seen is on the east side of Ash bay, where it is in contact with the older ellipsoidal trap, and by brecciating this material has formed an agglomerate (see figs. 5-8).

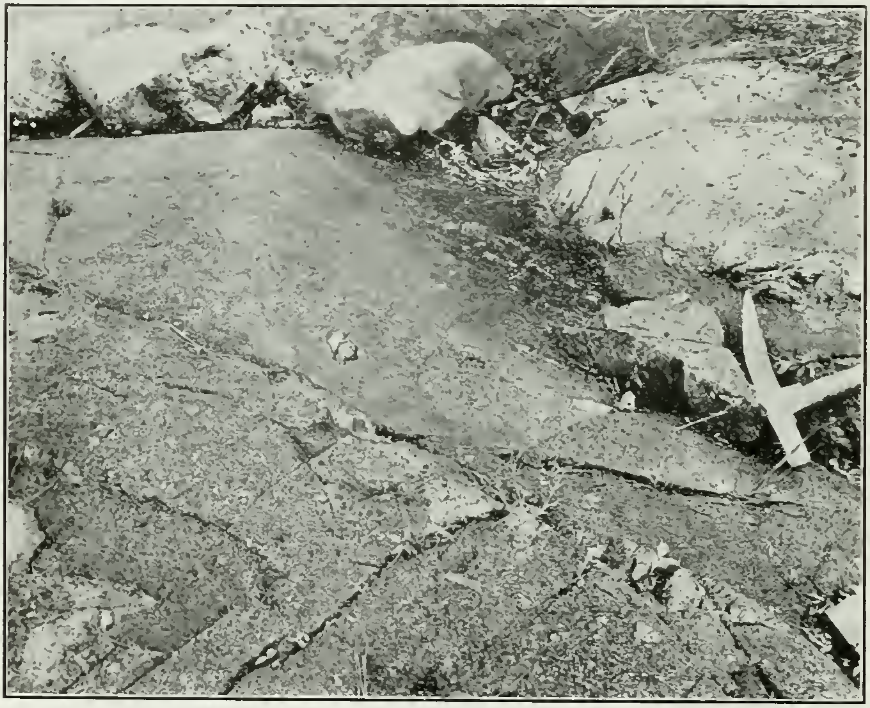

Fig. 7.—Igneous breccia, Ash bay, Lake of the Woods.

At the contact of the Keewatin with the Laurentian (and other ?) granites is a metamorphosed rock which in some places appears to result from the recrystallization of these ancient traps. In many cases it is impossible to judge from an examination of the contact zone whether these highly altered rocks represent a different kind of rock or are merely re-crystallized Keewatin traps, since the softer unmetamorphosed rock has been entirely removed. It was found, however, on the north side of Andrew bay and on the west side of Bottle bay that the highly altered dark-coloured hornblendic rock in contact with the granite grades into the less altered Keewatin traps and schists. This highly altered rock is very liable to be brecciated by intrusions of the underlying granite, and the resulting breccia serves as an indication of the contact when most of the trap has been denuded.

Ankerite Deposits

In most of the schists and accompanying most of the veins is an appreciable percentage of ankerite or ferro-dolomite. In many cases the quantity is not sufficient to be of more than scientific interest. Three outcrops of considerable size were observed during the past summer. The first is a small islet east of Whiskey island, which has weathered to an ochre yellow. On taking samples it was found that the rock is principally a light-coloured carbonate with small quantities of sericite and quartz. It apparently results from the alteration of a squeezed agglomerate of the friction breccia type.

A second outcrop was found on a small islet north of Square island. This is of the same character as the former, but contains more sericite. This second body of ankerite apparently continues across Square island, as another outcrop appears on the mainland east of Square island in the same line of strike.

From an economic point of view these are of little value at the present time except as gold may accompany them. In case an iron industry were developed in this region, the first mentioned might furnish a valuable flux.

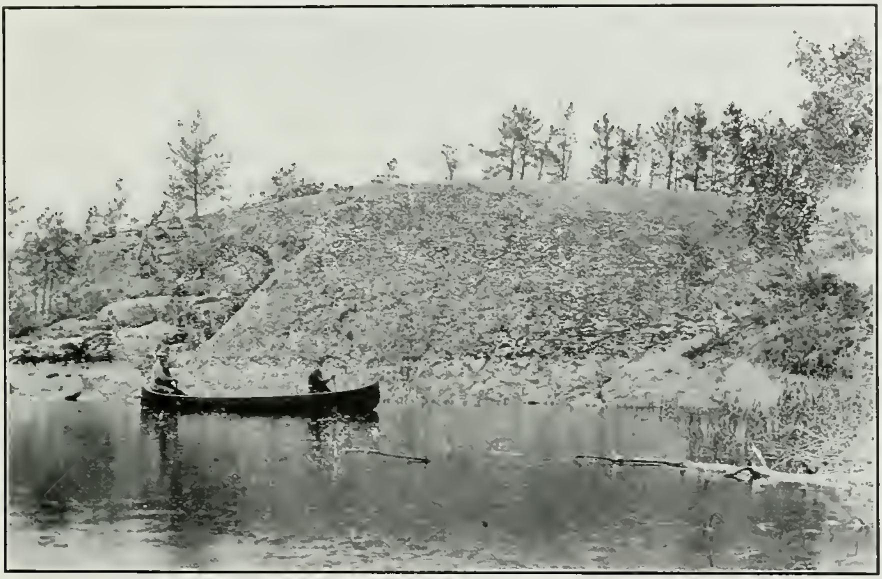

Fig. 8.—Igneous breccia (agglomerate), Ash bay, Lake of the Woods

Carbonaceous Schists

Among the less prominently developed rocks of this region may be mentioned a series of black schists, which are known as graphitic or carbonaceous schists. These rocks split very easily, and usually present a black glossy surface. They are generally, if not always, associated with the sericite schists, and are looked upon as an indication of the sedimentary origin of these rocks. It has, however, been suggested that these bodies are more of the nature of vein material; and there is much to be said for each theory of origin. In structure they vary from a black fissile schist to a dark slaty rock, and much of the material is characterized by spherical cavities surrounded by quartz. The cavities often contain pyrite either in a fresh condition or altered to limonite. The schist contains crystallized pyrite also, which has been distorted by pressure, and the crystals frequently are more than half an inch across. The vesicular portion of this rock has been sectioned, and its character is shown in fig. 9. In this illustration the dark portion represents the carbonaceous material, the lighter coloured fibrous portion is quartz of somewhat chalcedonic character, and the intermediate tone shows the cavities. The picture was taken with polarized light, but the nicols were inclined at an angle of about 75°, so that the contrast might be shown between the cavities and the quartz and carbonaceous material. The body from which this sample was taken is located near the northwest point of Corkscrew island, and is probably an easterly extension of the outcrops of the same material about three miles southwest of Zig-Zag point. The vesicular structure can probably be best explained by the expansion of gaseous matter in the rock, and is probably due to the caking of carbon compounds which may have been coal-like deposits or an asphalt vein filling. In either case a natural coke would be formed similar to such deposits in later geological horizons in Virginia. The quartz surrounding the cavities is undoubtedly due to the percolating of water containing silica, and the pyrite is due to crystallization from solution.

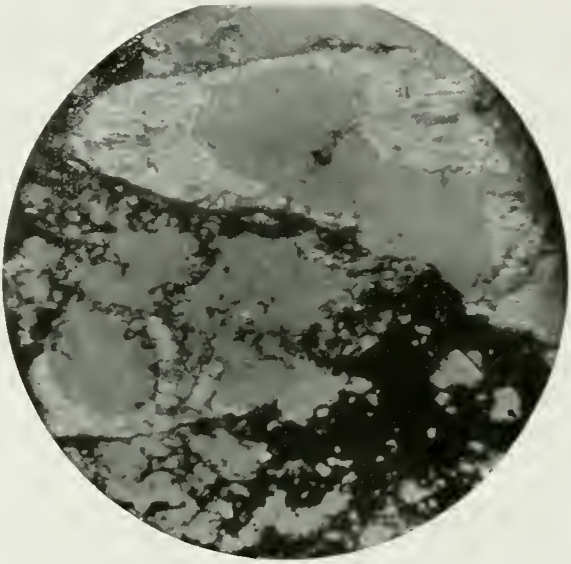

Fig. 9.—Carbonaceous schist, Corkscrew island, Lake of the Woods.

Keweenawan Eruptives

A remarkable series of dikes which are probably of Keweenawan age crosses Lake of the Woods and Shoal lake in a general northwest-southeast direction. The continuation of some of these has been traced in the Rainy lake region, and a minimum length for some of the better developed dikes is roughly one hundred miles. The most northerly outcrop of the dikes shows them to be as well developed as they are in other parts and it is unknown how much farther they may be found, but there is no indication that they are about to disappear. In their petrographic character they are quite distinct from the other basic rocks of the region, and with their clean-cut contact and brown colour they are easily recognized even at a distance. The age of the dikes cannot be definitely determined in the Lake of the Woods region, but it is later than any of the crystalline rocks there. From a comparison with the eruptive rocks of Minnesota it would probably not be wise to refer them to a later age than the Keweenanan. They are later than the Laurentian, much of which is post-Lower Huronian in age.

The general character of the dikes and the petrographic description has been given by Dr. A. C. Lawson,[3] and for the most part the writer agrees with his description.

Petrographically, the main mass is a quartz-diabase consisting of labradorite, augite, quartz, and ilmenite. This composition is, however, not constant, as quartz is not found in all the sections, though the other constituents are never lacking except in altered rock. The ilmenite is quite largely altered to leucoxene and is a very characteristic constituent of the rock. Dr. Lawson mentions the presence of garnet in these dikes as an original mineral, but no trace of this was found in the writer's sections. The augite in some cases has been uralitized, with the formation of secondary hornblende. At the contact of the dike with the adjoining rocks the character is very different from the central portion, being a porphyritic diabase with phenocrysts of augite and enstatite in a dark ground-mass. On Micrometer island a dike cuts the later granite and the contact is marked by a band about an inch wide which shows an abundance of moderately large crystals of augite and a few long narrow crystals of enstatite. This is succeeded by a fine grained trap with few phenocrysts of augite and relatively more enstatite in a ground-mass which is of about the same character as in the contact zone (figs. 3, 10, 11). From this point the texture becomes coarser and the typical ophitic texture becomes apparent until at the centre the rock has assumed almost a granitoid appearance. The metamorphic effect upon the granite is not very pronounced, but some crushing is to be noted. The effect of the dike in metamorphosing the adjoining rocks is best shown when in contact with sericite schist. On the east side of Slate island a good example of this is to be seen. The character of the dike is very similar to that on Micrometer island, but shows more enstatite and some feldspar in addition to the augite. The contact is very sharp (fig. 12), and shows no indication of any solvent action by the dike, but the character of the adjoining rock has been changed both by crumpling (fig. 13) and by the formation of new minerals. In the original rock, which may be seen in a comparatively unaltered condition about twenty feet from the dike, the prominent constituents are sericite and ankerite or ferruginous dolomite. In the metamorphosed contact zone they are sericite and epidote with some hornblende. On Thompson island the schist near the contact contains not only the above-mentioned minerals, but also grains of magnetite and hematite.

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[3] Geol. Surv. Can., Vol. III., Pt. F., pp. 147-163.

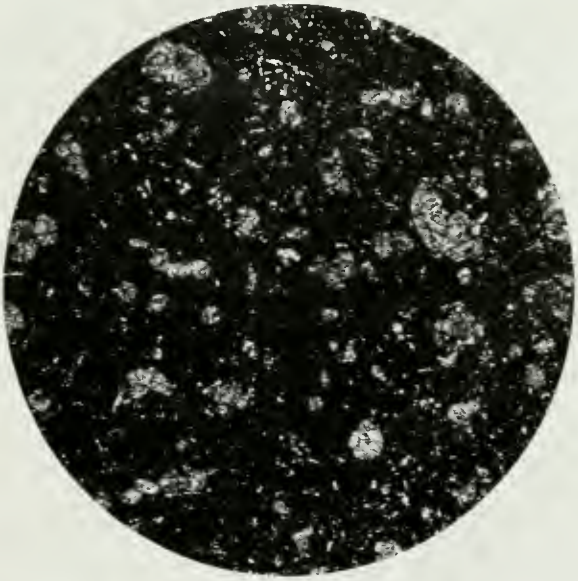

Fig. 10.—Keweenawan trap, two inches from granite contact, Micrometer island, Lake of the Woods.

In decomposing, the dike usually shows a brown surface, but on Allie island it appears to give rise to a green serpentine rock which contains copper, though this mineral has not been found in other parts of the dikes. It would seem that the situation of the dike in this place has resulted in a difference of conditions for alteration, as the copper-bearing portion is in a sheltered bay, where wave action would not remove the decomposed material so that greater alteration is apparent than usual. It is possible that the altered material represents a more basic phase of the dike than is common, which would possibly shed light on the interpretation of the rocks at a few places where the dikes are apparently interrupted.

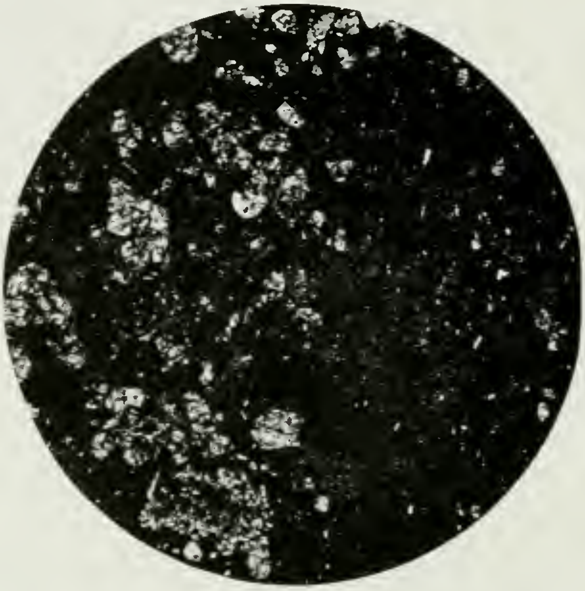

Fig. 11.- Keweenawan trap, one inch from granite contact, Micrometer island, Lake of the Woods.

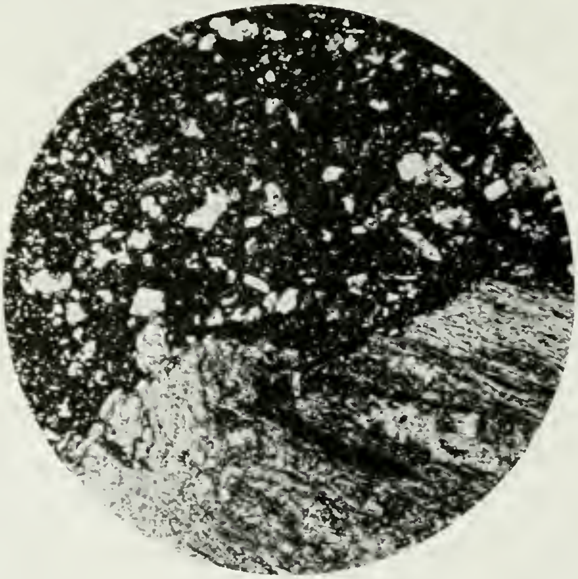

Fig. 12.—Keweenawan trap and Keewatin schist, Slate island, Lake of the Woods.

The extent of these dikes is not fully known, and others will probably be found. At present there are four well-defined dikes having a northwesterly-southeasterly strike and one having a northeast-southwest strike. Two of these, the Thompson island dike and the Massacre island dike, were partially mapped by Dr. Lawson, and the other three were found by the writer during the past summer. It is possible that the Whiskey island dike unites with the Welcome channel dike, and the latter with the Thompson island dike, but the exact relations are not known. It is known where the Welcome channel dike intersects the Thomson island dike, as they can be traced to the water's edge and are not more than fifty feet apart on the shore, but it cannot be definitely shown whether they are of the same or of different age, as their contact is under water. The Welcome channel dike, however, differs materially in its petrographic character from most of the outcrops of the other dikes. The thin sections show it to be an almost completely serpentinized porphyritic pyroxenite (fig. 14), and it might be supposed that it represents a different type of eruption from the other dikes. This, however, is probably not the case, as a similar rock is found in the line of strike of the Thomson island dike on the channel between the Tangle islands and Rat Portage bay. At this point no outcrop of the typical quartz diabase could be found, and it was supposed that the dike was interrupted. It would seem, however, that in some places these dikes are much more basic than is ordinarily the case, and it is probable that the Welcome channel dike represents a more basic phase of the Keweenawan, similar to the copper-bearing rock on Allie island, though not so much decomposed as this latter.

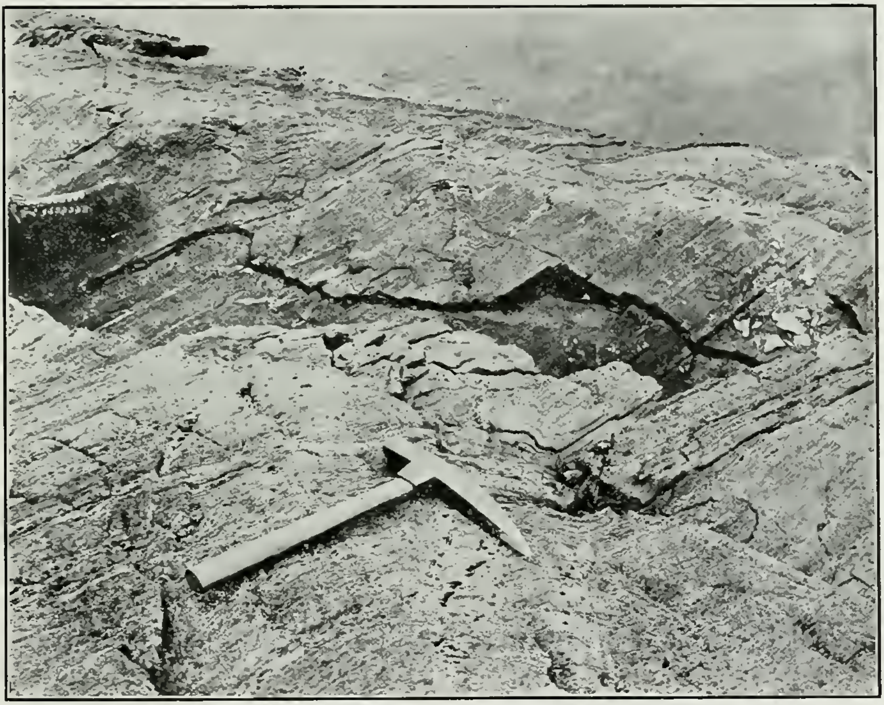

Fig. 13.—Altered sericite schist, showing crumpling near Keweenawan dike, Slate island, Lake of the Woods.

The Thomson island dike has been traced with but few apparent interruptions from the north side of Darlington bay to the southeast side of Whitefish bay, and what is probably its continuation has been mapped by Dr. Lawson on the Rainy Lake map. The Ptarmigan bay dike has been traced from the north side of Clearwater bay to the south side of Sabascong bay, with the exception that it was not found on Narrow lake. The Whiskey island dike is the narrowest of those found, and was only traced from Wolf island to the small island just west of Oliver island. It is suggestive, however, that at two places in Whitefish bay narrow outcrops of later trap were seen cutting the Laurentian granite about midway between the Thomson island and Ptarmigan bay dikes.

Gold Mines

During the summer there were three mines in which work was carried on to a greater or less extent; the Olympia, Cameron Island and Canadian Homestake (formerly the Scramble).

Prospecting and assessment work was carried on by Mr. F. Moore in the region between the Canadian Homestake mine and Black Sturgeon lake. Considerable work was also done by Mr. Gauthier on a property just west of the old Nonesuch mine on Ptarmigan bay, and also by Mr. Dorion on an island near Yellow Girl point.

Olympia Mine

This mine was visited July 2nd. At this time the caretaker, Mr. Hubner, with one man, was engaged in making an upraise in the tunnel near the mill. During the preceding winter 14 men were employed here, and Mr. Hubner reported that three gold bricks, of a value of about $3,000, were turned out.

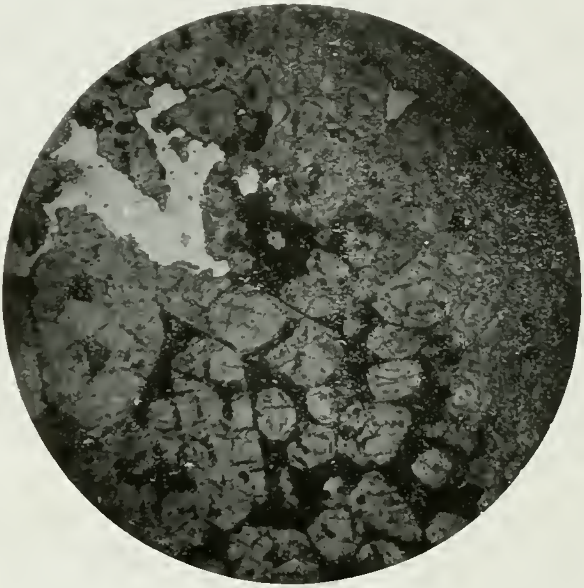

Fig. 14.—Serpentinized pyroxenite, Welcome channel, Lake of the Woods.

Ophir Mine

During the winter of 1911-12, Mr. R. B. Nickerson, M.E., sunk the shaft to a depth of about 160 feet. Work had been discontinued before the opening of the field season, and it was possible to visit only the first and second levels, the shaft below the second level being filled with water. The shaft follows the vein down to the second level, but below that point it is stated that it is in the foot wall. This statement is borne out by the evidence on the dump, or at least the rock on the dump would indicate that the lower part of the shaft is off the vein. Good camps and a new boiler-house and shaft-house were constructed.

The vein is in the porphyritic granite which is found at the Sultana mine in contact with the Keewatin traps, but at the Ophir none of the Keewatin rock appears. At the southwest end of the second level, 39 feet from the shaft, the vein consists of three distinct bands of quartz, 32, 6 and 9 inches wide respectively, with micaceous and chloritic schist between them. The total width of schist and quartz between the vein walls is 6 feet 8 inches, of which 3 feet 11 inches are quartz. One of the bands of schist is 15 inches wide and contains numerous lenses of quartz, which materially increase the total width of quartz given above, but exact measurements cannot be secured. The other band of schist is 18 inches wide and apparently contains very little quartz. At the northeast end of this drift the vein is very narrow. The southwest face of the drift on the first level shows three bands of quartz, 4, 4, and 24 inches wide respectively between granite porphyry walls, and separated from each other by two bands of the same rock. Apparently these are the same bands as those seen on the lower level, but the widest one on this level is the intermediate one of the second level, and the 32-inch band is here represented by only four inches of quartz. It is interesting to note that the granite bands of this level are replaced by schist bands in the lower level. Every facility for examining the property was furnished by Mr. James Morton, who was in charge.

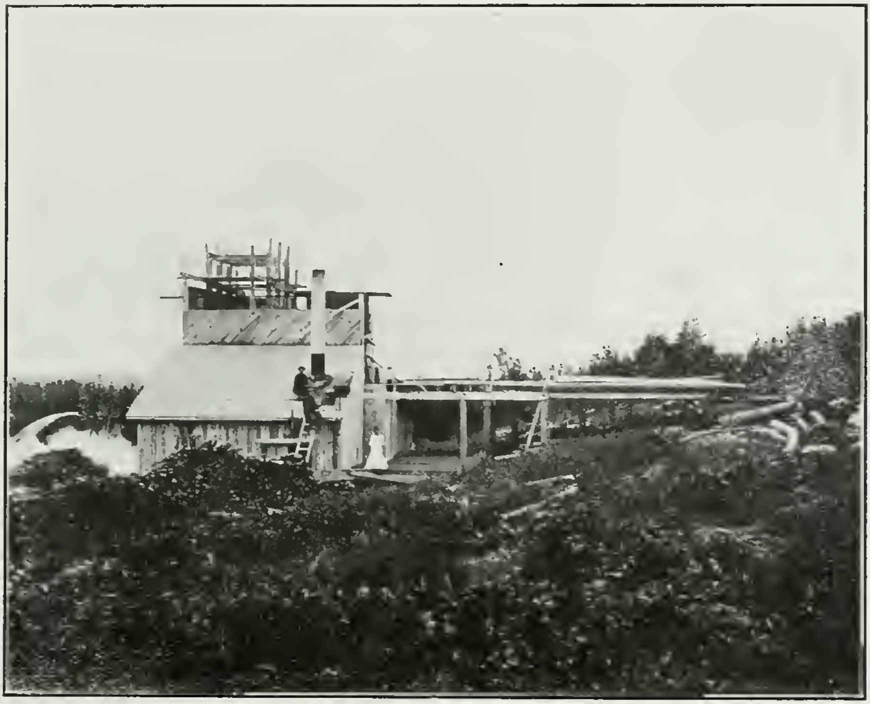

Fig. 15.—Shaft house of Canadian Homestake mine in course of erection.

Canadian Homestake Mine

During the preceding year development work was continued on the Canadian Homestake mine, under the management of Mr. Joseph Hicks, of Kenora. The equipment at the time of the writer's visit was of a temporary nature, and consisted of a small boiler, hoist, pump, compressor and drill. It was the intention to replace this equipment with electrical machinery, and the poles for the power line from Kenora had been put in place. It is reported that the permanent machinery has since been installed. It was not possible to see all the workings, as operations had been temporarily discontinued on account of performing assessment work on adjoining claims. It was, therefore, impossible to go below the 50-foot cross-cut on account of water, and no very good idea of the vein could be secured. The ore body consists of a fahlband or schistose band about 30 feet wide, which contains veins and stringers of quartz and ankerite and considerable pyrite. The company claim an average value for the ore of about $3.50 per ton.

A new shaft house was in course of erection at the time of the writer's visit, and the progress is shown in the accompanying illustration (fig. 15).

Cameron Island Mine

On July 1st, the Cameron Island mine was visited. Work at the mine had been resumed only a few days previous, and ten men were employed. The mine had been pumped out and an upraise started in the second level. The mill had also been overhauled. Just as the preliminary work was nearly finished, the manager, Mr. F. Pfau, died, three days before the writer's visit. The underground conditions were practically the same as seen on the visit two years before, as only about three days' work had been done in starting a stope. Underground work had not been resumed, as the men were awaiting the arrival of Mr. D. M. Cameron, trustee of the Cameron Island Syndicate, who was expected that day. Since that time it is reported that a mill run has been made, and that preparations are being made to erect a smelter.

The Sultana, Regina, Mikado, Combined and Bully Boy mines were all in charge of caretakers, and no work had been done on any of them in the preceding year. It is expected that work at the Mikado will be resumed in the near future, and negotiations looking to reopening of the Regina are reported.

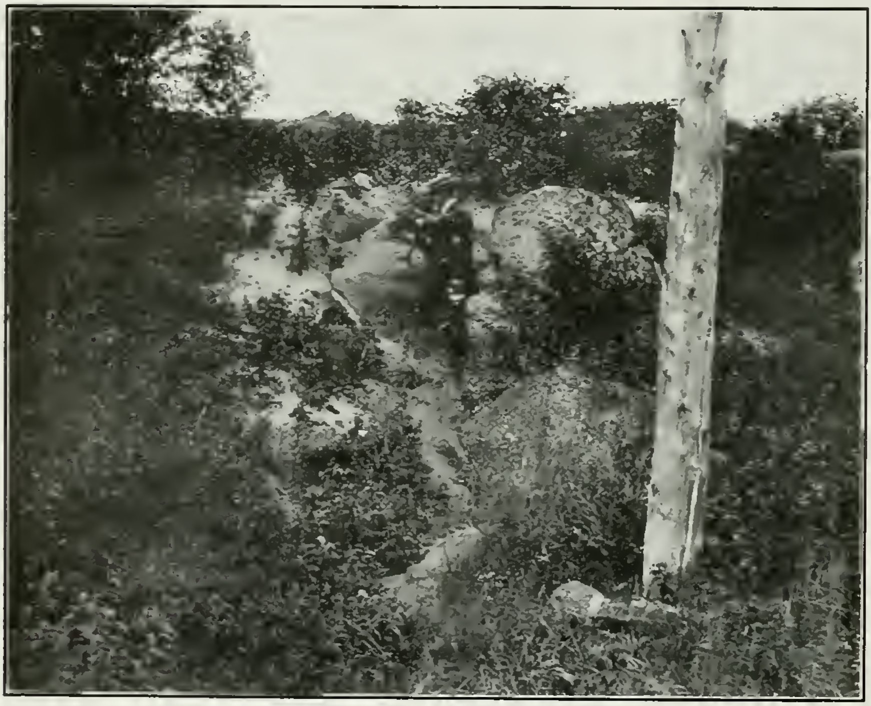

Fig. 16.—Nepheline syenite, showing concentric weathering, Port Coldwell.

Dryden District

In this region considerable development work has been done in the past year.

Mr. G. Larson has sunk a shaft 40 feet deep in a great fahlband or schistose vein about 20 feet wide on mining location S.V. 372. The vein is well mineralized with pyrite, chalcopyrite, galena and a little sphalerite.

Test pits have been sunk on four veins on the northwest quarter of the south half of 7 in the first concession of Van Horne township by Mr. E. Rognon. The widest of these veins shows five feet of quartz, and the owner reports satisfactory values.

The Gold Moose shaft has been sunk to a depth of 114 feet, and Mr. Rognon reports that the vein, which at the surface is about 18 inches wide, shows a width of four feet at the bottom of the shaft.

On the Gordon claim, the Dryden Mining Company have sunk two shafts, one 90 feet deep and the other 43 feet deep. Two cross cuts, of 21 and 18 feet respectively, and a drift 50 feet long have been opened up in the first of these.

At the League mine the shaft is 80 feet deep, and a drift has been started toward the east at a depth of 72 feet for the purpose of making a mill-run and testing a new type of amalgamator and amalgam trap.

On the Good Luck claim two shafts have been sunk to a depth of 65 and 45 feet respectively.

Port Coldwell

The work at Port Coldwell was limited to two days, which were entirely devoted to outlining the Congress excursion. The rocks in this region have been described by H. L. Kerr.[4] The beauty of the rocks at this place, combined with the excellent shipping facilities both by rail and water, should result in the opening of quarries and the development of an important industry. The nephaline syenite, with its deep orange-red mottling from the alteration of the nephelite, would furnish a most beautiful stone for interior work, though it is probable that it would not be satisfactory for outside work. The red syenite and the darker laurvikite are both suitable for exterior work, and should find a ready sale in the larger cities on the great lakes, both in Canada and the United States.

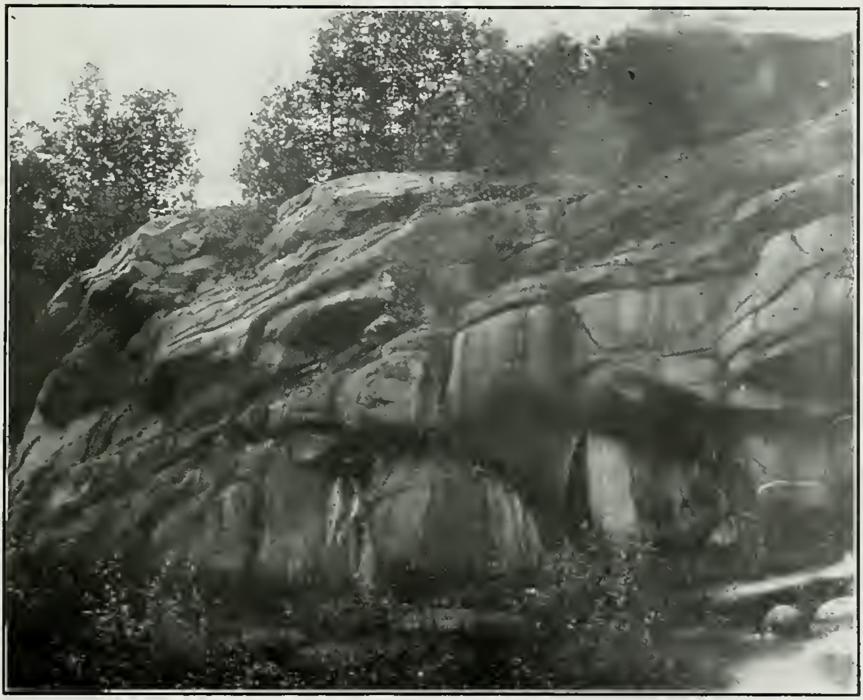

Fig. 17.—Nepheline syenite, showing concentric weathering, Port Coldwell.

Some peculiar effects of weathering are to be seen in this region (figs. 16, 17), by which large rounded boulders result from the decomposition of the syenite. This seems to be the ordinary concentric weathering which is not uncommon in traps, but is not known to be common in the pre-Cambrian rocks of Ontario. It suggests the question whether many of the granite boulders in this region may not have a similar origin, and bears directly upon the problem of the glaciation of the region.

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[4] Bur. Mines, Vol. XIX., Pt. I., pp. 194-232.

Loon Lake

The work at Loon was devoted entirely to preparing for the Congress excursion. At the present time no mining is being done in this vicinity, and conditions seem to be about the same as they were at the time Mr. L. P. Silver[5] made his report on this region. In visiting the remarkable conglomerate one mile west of Loon (fig. 18) it was found that some of the boulders consist of compact datolite of a creamy pink colour. This material should, if found in sufficient quantity, make an attractive gem stone. It is comparatively soft for this purpose, but has about the same hardness as the thomsonite and chlorastrolite which are sold in large quantities in Port Arthur.

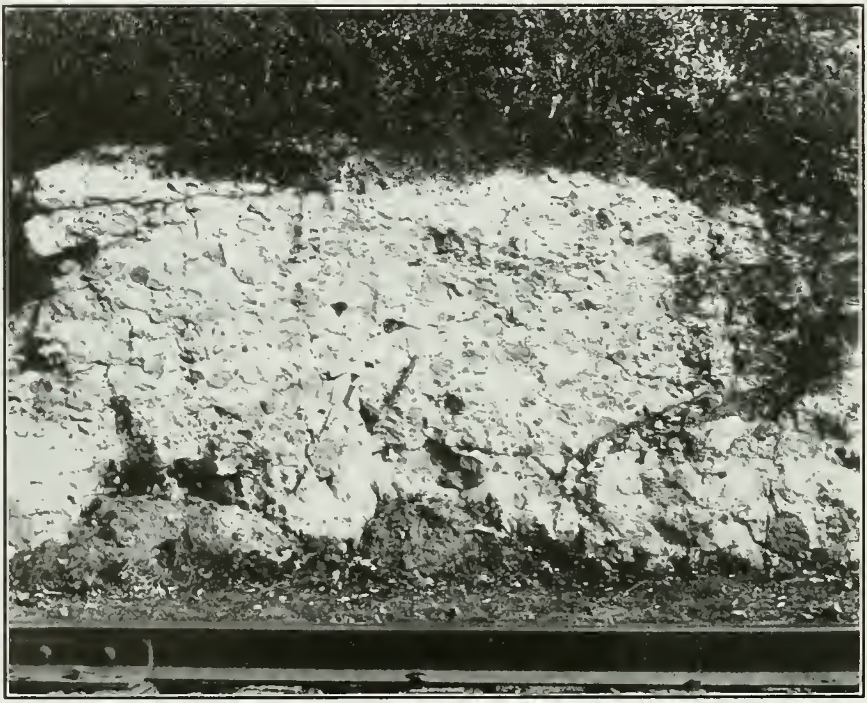

Fig. 18.—Keweenawan conglomerate, one mile west of Loon.

Geologic Section Cartier to Manitoba Border

The section along the Canadian Pacific railway was made primarily for use in the guide books of the International Geological Congress. The part between Margach and the Manitoba boundary was made carefully on foot, the other part was hastily covered according to later instructions, and represents what can be seen from the railway train.

The region traversed by the Canadian Pacific railway between Cartier and the Manitoba boundary is characterized by pleistocene deposits of glacial debris and stratified sands, gravels and clays. Underlying this and in most places protruding through the later deposits are great masses of pre-Cambrian rocks which belong to four or possibly five formations, Laurentian, Keewatin, Lower Huronian, Animikie (Upper Huronian) and Keweenawan. In this description no attempt is made to differentiate the Keewatin from the Lower Huronian, and all doubtful rocks are classed as Keewatin.

Because of the uneven surface of these rocks the region contains unnumbered lakes and numerous rivers which give diversity to the scene. These lakes and rivers are the principal avenues of communication with the region at a distance from the railway.

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[5] Bur. Mines, Vol. XV., Pt. I., pp. 156-172.

Along the north shore of Lake Superior the country has a different aspect but, except where the Animikie and Keweenawan are present, the difference is more apparent than real, as the region to the north abounds in lakes.

The predominant series of rocks is the Laurentian, which consists of granites and gneisses. These are so abundant that no tabulation of outcrops is given. Unless otherwise specified the rocks are Laurentian.

Keewatin and Lower Huronian

Outcrops of Keewatin and Lower Huronian are exposed at the following places:—

3	miles to	12½	miles west of	Cartier, near Geneva, Bennet and Stralak.
62	“	64	“ “	“ between Roberts and Sheldon.
66	“	67	“ “	“ “ Sheldon and Ramsay.
9½	“	11½	“ “	Chapleau, between Esher and Pardee.
47½	“	58	“ “	“ near Dalton, Carry, Cowslip and Missinabie.
61	“	72½	“ “	“ “ Missinabie, Gutelius and Lochalsh.
87	“	88	“ “	“ “ Williams.
19½	“	22	“ “	White River, between Bremner and Montizambert.
24½	“	41	“ “	“ “ near Montizambert, Trudeau, Struthers and Hemlo.
46	“	61	“ “	“ “ “ Pringle, Melgund, Heron Bay and Peninsula.
84	“	100	“ “	“ “ “ Middleton, Ripple, Steel, San Toy and Jackfish.
117	“	119	“ “	“ “ “ Schreiber.
0	“	5	“ “	Schreiber.
106	“	107½	“ “	“ near Beck.
115	“	120	“ “	“ “ Mackenzie.
18	“	42	“ “	Fort William, near Kaministiquia, Finmark and Buda.
72	“	west of Fort William, near Savanne.		
84	“	87	miles west of	Fort William, near Upsala.
10	“	23	“ “	Ignace, near Butler, Raleigh and Bigsby.
26	“	65	“ “	“ “ Taché,—Dyment, Brulé,—Dinorwic, Wabigoon, Barclay and Dryden.
108	“	110	“ “	“ between Edison and Snell.
111	“	west of Ignace, between Edison and Snell.		
123	“	west of Ignace, near Hawk.		
140	“	146	miles west of	Ignace, near Kenora.
0	“	7	“ “	Kenora, near Kenora, Norman and Keewatin.

Animikie and Keweenawan

The rocks of these two formations are usually exposed together along the railway. The Animikie is represented principally by slates and iron formation, while the Keweenawan is represented usually by sills of diabase intruding the Animikie. Near Loon lake the Keweenawan is also represented by a conglomerate.

The outcrops are seen at the following places:—

35	miles to	38	miles west of	Schreiber, near Hartley.
41	“	50	“ “	“ “ Dublin.
52	“	54	“ “	“ “ Ozone.
59	“	60½	“ “	“ “ Ruby.
62	“	75	“ “	“ “ Nipigon, Red Rock and Sprucewood.
85	“	88	“ “	“ “ Dorion.
100	“	106	“ “	“ “ Loon.
121	“	128½	“ “	“ “ Port Arthur.

Nepheline Syenite Series

Near Port Coldwell is a series of nepheline syenites and associated rocks extending from 61 miles to 84 miles west of White River.

Regions in which the rock is covered to such an extent that it was not possible to definitely determine the relationships:—

29	miles to	34	miles west of Schreiber.
38	"	41	" " " near Gurney.
54	"	59	" " " " Fire Hill and Ruby.
61	"		west of Schreiber, near Ruby (contact zone).
75	"	85	west of Schreiber, near Hurkett.
128½	"	132	" " between Port Arthur and Fort William (probably underlain with Animikie).
0	"	17½	Fort William, near Westport and Murillo (probably underlain with Animikie).
48	"	50	Ignace, near Wabigoon (probably underlain with Keewatin).
70	"	80	" " Oxdrift Minnitaki and Eagle River (probably underlain with Laurentian).

Regions not seen:—

88	miles to	91	miles west of Schreiber. near Ouimette.
97½	"	100	" " " " Pearl.

THE WEST SHINING TREE GOLD AREA

By R. B. Stewart

Late in May, 1912, the writer was instructed by the Provincial Geologist to proceed to West Shining Tree and continue the examination of that area made during September, 1911.

Mr. Dowler Freeman served as assistant.

Transportation facilities have improved during the year. The regular train service on the Canadian Northern railway has been extended to Ruel, sixty-six miles from Sudbury. Two dams were built in the fall of 1911, on the Opickinimika river in order to deepen its shallow portions. This enables small gasoline boats or pointers to run from Ruel to the north end of Allin lake, which is 1½ miles from West Shining Tree lake. Mr. Thomas Clemow, of Ruel, had two boats on the route during the season, giving a tri-weekly service to West Shining Tree lake.

A wagon road will be built during the coming season into the area from mileage 80 on the Canadian Northern railway.

Mr. John Moore, of Sudbury, has established a general store and accommodation for travellers on the south side of West Shining Tree lake. In September, a post office (Tungsten) was established at the store with Mr. Moore as postmaster.

During the year considerable development work has been done. Assessment work was performed on a large number of claims, and a number of the most promising properties and adjacent holdings have been surveyed. In several places, shafts 20 to 50 feet deep have been sunk, and in other places open cuts have been made, chiefly on properties under option.

Geology of the Area

The rocks of the area are chiefly of Keewatin age. They consist of ellipsoidal basalts, altered diabases, amphibolite and hornblende schist. The ellipsoidal rocks predominate. Small areas of quartz porphyry, syenitic porphyry and felsite resembling rhyolite are also present.

A schistose structure exists in most of the Keewatin, but is most pronounced in narrow shear zones that have a general east-west trend, and the developed schists dip nearly vertical. Ferruginous calcium and magnesium carbonates are present in much of the schist.

A lamprophyre dike cutting the older Keewatin rocks was observed on the boundary between Churchill and McMurchy, about 20 chains from the southwest corner of the latter township.

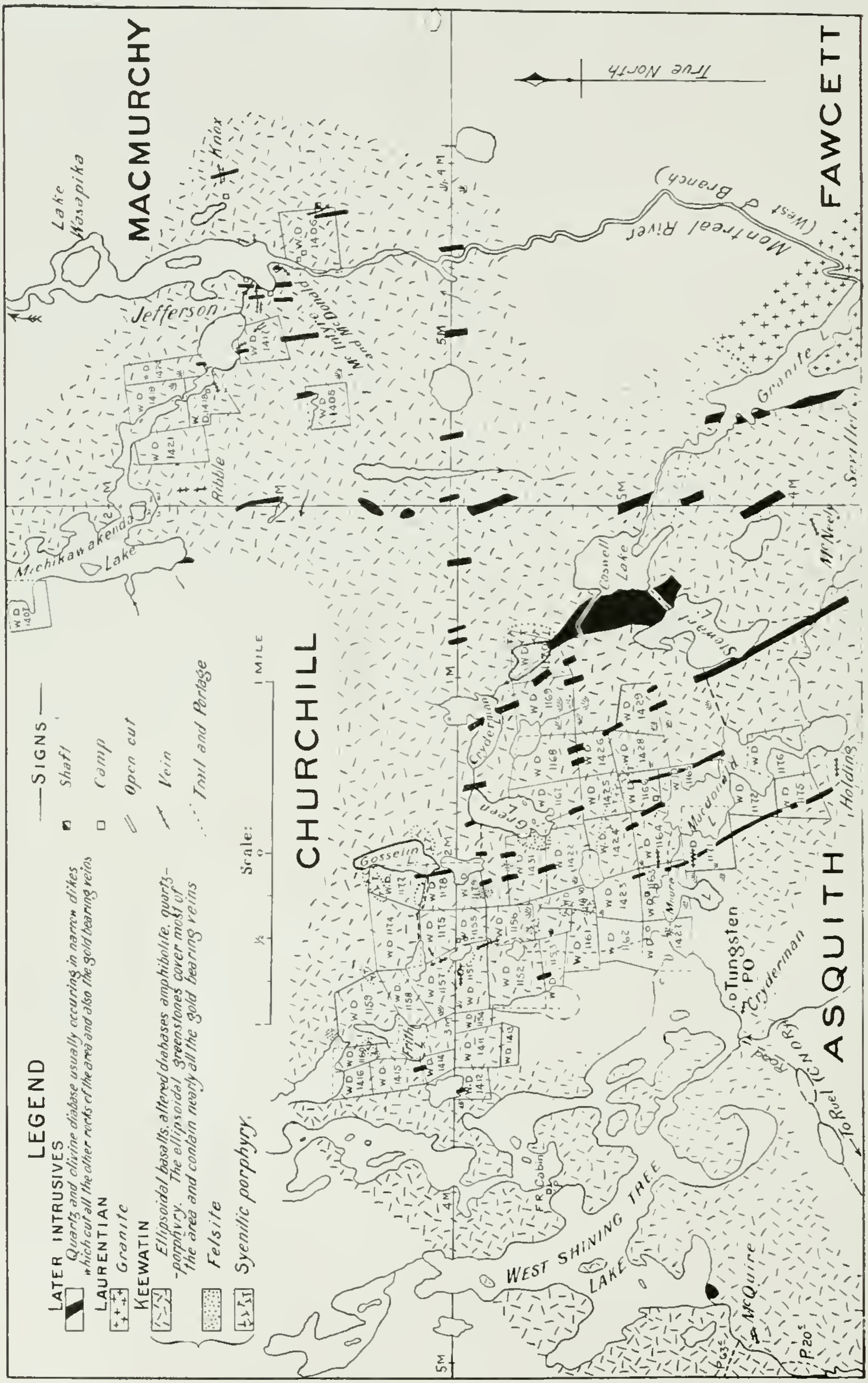
Numerous dikes and small areas of fresh quartz and olivine diabase are found in the area. The diabase dikes intrude all other rocks, and also cut the gold-bearing veins.

Auriferous Quartz Veins

A large number of quartz veins occur in the Keewatin rocks and many of them contain visible gold. Most of the veins are in the ellipsoidal basalt, but two gold-bearing veins have been found in the hornblende schist.

The veins vary in width from 15 feet to a few inches, but most of them are less than 4 to 6 feet across in the widest parts. They present little uniformity in width. They pinch out or narrow to mere stringers in a few yards, then widen again or break up into stringers. The dip of the veins is usually nearly vertical, but several dip at much lower angles,—45 degrees or less.

Considerable variation is presented in the strike of the veins. Many veins occur in the east-west shear zones, and conform in a general way to the strike and dip of the enclosing schists. Others having an approximate north-south strike occur in the more massive rocks.



Sketch Map, showing geology in the vicinity of West Shining Tree Lake.

Several irregular masses of quartz or quartz and schist occur. The largest one that has been found, so far, is on W.D. 1157. It is roughly 160 feet long and 60 feet wide.

The veins and adjacent country rock are usually well mineralized with iron pyrites. Specular hematite and barite are sometimes present. Much rusty decomposed material resulting from the oxidation of the pyrites and the decomposition of the ferruginous carbonates is almost invariably associated with the veins.

Several small areas of felsite and porphyritic syenite are found in the vicinity of the veins just east of West Shining Tree lake. The latter rock occasionally contains many stringers of quartz cutting it in a very irregular manner and sometimes veins of quartz 3 to 4 feet wide.

Gold occurs in many of the quartz veins and to a small extent in the enclosing schists. Much of the gold in the quartz is in a fine state of division, but nuggets several grains in weight are frequently found. Examination of several specimens showed that a large amount of the gold has been deposited along fracture lines in the quartz. The schist immediately adjacent to the veins appears to be impregnated with quartz to a certain extent, and contains some gold, but assays of several samples of schist taken in the vicinity of the veins do not indicate that the amount of gold in the schist is of importance.

Gold Claims

Gosselin

The mining locations, W.D. 1151-52 and W.D. 1155-56-57-58 and 59, are commonly known as the Gosselin claims. The first discovery of gold in the area was made on these claims. A mass of quartz about 160 feet in length and 60 feet wide occurs on W.D. 1157. Gold has been found in this outcrop. Just east of this quartz body is a vein 3 or 4 feet wide, striking about north and uncovered for about 100 feet. About three chains to the north of this vein is a mass of quartz 50 feet long and about 15 feet wide that contains some visible gold, and immediately east of here on W.D. 1175 is a mass of quartz extending 70 feet in a northeasterly direction and about 15 feet wide. Near the northern boundary of W.D. 1151 is a vein 1½ to 2½ feet wide, having an east-west strike and dipping to the north at about 45 degrees. Gold was observed in this vein. Another vein has been located southeast of this claim and extends into W.D. 1156. It has been traced for 8 or 9 chains. The vein strikes a little west of north and varies in width from a few inches to 15 feet. Gold was seen in several places. This is a promising looking vein.

A company from Duluth had an option on the properties early in the year. Surface work was carried on to determine the extent of the quartz bodies and these were systematically sampled. A shaft was put down 50 feet on the incline on the east-west vein on W.D. 1151.

Caswell Claims

Claims W.D. 1418-19-20-21 constitute the Caswell property. They are situated west of lake Wasapika, in MacMurchy township. Several veins have been located, but the one which has attracted most attention occurs on the south end of W.D. 1410 and appears again across the lake on W.D. 1418. The vein is of the east-west type and is seldom over a foot wide. The rusty weathering schist alongside the vein contains many stringers of quartz.

The claims were under option during the winter. Most of the development work carried out was done on the vein described above. An open cut 25 feet in length and 12 feet deep at the face was put in on the east shore of the lake on W.D. 1420. Some very fine specimens of gold were obtained, but the work was discontinued when the option had expired.

Seville Claim

Claim W.D. 1417 is located west of the south end of lake Wasapika. The outcrop of a vein that appears to strike several degrees west of north occurs near the east side of the claim. An open cut 30 feet in length and 16 feet deep at the face has been made here. The quartz at the face is about 6 feet wide and well mineralized with pyrites. A little gold was observed in the bottom of the cut. The vein pinches out about 30 feet north of the cut, but comes in again for a short distance and then is concealed by the drift. Along the strike of this outcrop another one occurs near the northern boundary of the claim. The quartz is about a foot wide and contains visible gold. Another outcrop 3 feet wide and uncovered for a chain and a half occurs at the south boundary of W.D. 1418. These three outcrops probably belong to the same vein.

Jefferson Claim

The claim is not surveyed. It is situated immediately east of the Seville property. Gold was first found on this property in a vein that occurs on the west side of lake Wasapika. This vein has an east and west strike and dips 60 degrees to the north. It has been uncovered for over a chain. The quartz is about four feet wide, but pinches out several times. Considerable iron pyrites occurs in the quartz. Finely divided gold was observed about the centre of the outcrop.

Six chains west of this vein, another outcrop has been uncovered for about 200 feet. It has a similar strike and dip to the one described, but the quartz is narrow and irregular.

Two chains north of the latter vein, another has been uncovered for about 200 feet. It strikes a little south of east and is nearly vertical. The quartz is about 2 feet wide and maintains its width fairly well. Pyrites is abundant in the quartz. Much gold was observed in many places in this vein.

The Bennett Claim

This claim (W.D. 1406) is situated on the east side of the Montreal river just south of lake Wasapika. During the fall of 1911, a vein carrying visible gold was discovered along the eastern side of the claim and running into the adjoining property. It appears to strike about northwest, and has been uncovered for about four chains. The quartz in the vein is seldom over a foot wide, but many stringers occur in the vicinity of the vein. Gold was observed in several places in the quartz. An option was secured on the property to the east, and a shaft 34 feet deep was sunk just east of the line. Encouraging quantities of gold were found in the quartz taken from the shaft. This vein occurs in the ellipsoidal greenstone.

Knox's Claim

The claim is located east of lake Wasapika. Several veins varying in width from three to fifteen inches occur in a greenish-gray schist. Their general strike is a little north of east. Coarse gold was observed in one of the veins.

MacDonald and MacIntyre Claim

This property is located just south of lake Wasapika. Very little work has been done on it during the year. Outcrops of quartz and small areas exposed by surface work extending a distance of 8 to 10 chains seem to indicate the existence of a vein running southwest from the west side of the Montreal river and gradually bending to the west. The quartz is four feet wide in places. No gold was observed in this vein, but farther north a vein has been uncovered for a short distance that contains considerable free gold. The latter vein seems to strike west of north and dips to the east. It is two feet wide in some parts. The formation is rather massive greenstones, but some schistosity is developed. Much rusty material occurs in the vicinity of the veins. An option was taken on the property in September, and a shaft was commenced on the vein where the free gold occurs.

Moore and MacDonald Claims

These claims are situated in the vicinity of Moore lake. Several east and west shear zones, 60 feet wide or more, have been located on the properties. The shear zone on W.D. 1164 has been traced for 9 or 10 chains. What is apparently a continuation of this one has been located on W.D. 1163 and on W.D. 1427. Similar areas have been located on W.D. 1171. These shear zones contain many quartz veins and stringers, and are usually well mineralized with iron pyrites. The quartz is seldom over a foot wide, and constitutes a small fraction of the mineralized areas. Much rusty, leafy schist adjoins the quartz and good colors can frequently be obtained from this material on panning. Considerable gold was observed in the quartz veins and stringers on W.D. 1171.

The MacQuire Claim

This claim is located south of the southwestern bay of West Shining Tree lake. Several veins 8 to 10 inches wide occur in hornblende schist and are uncovered for a short distance. The veins dip to the north. A large amount of iron pyrites occurs in the quartz and schist. It is reported that rich samples of gold were obtained here.

Holding's Claim

In September of this year, Mr. R. Holding, of Chapleau, made a promising discovery of gold west of the south end of MacDonald lake. The formation here is amphibolite and hornblende schist. Gold occurs in the quartz and decomposed schists. Surface work was in progress when the writer left the field.

Surveyed Claims

Following is a list of mining claims surveyed at West Shining Tree lake, with the names of their stakers or owners. These are shown on the map, page 234.

Bennett, W.D. 1405-6-7.
Beilby, W.D. 1173-74.
Caswell, W.D. 1418-19-20-21.
Clark, W.D. 1169-70.
Coleman, W.D. 1411-12-13.
Coombs, W.D. 1175.
Coulson, W.D. 1166-67-68.
Frith, W.D. 1157-58-59.
Fulton, W.D. 1162.
Gosselin, W.D. 1151-52.
Hanch, W.D. 1430.
Johnston, W.D. 1426, 1428-29.
Lennon, W.D. 1415-16.
MacDonald, W.D. 1163, 1164, 1172.
Moore, W.D. 1177-78, 1431, 1165, 1171.
Odlum, W.D. 1154.
Pendleton, W.D. 1161.
Peterson, W.D. 1422-23.
Seville, W.D. 1417.
Speed, W.D. 1155-56.
Thompson, W.D. 1176, 1424-25, 1427.

GLACIAL PHENOMENA OF TORONTO AND VICINITY[1]

By A. P. Coleman

Introduction and Geological Summary

Toronto began about 100 years ago as a village at the mouth of the small river Don, where a sand bar, now called Toronto island, enclosed an excellent harbor. It has since expanded six miles west to the Humber river, four or five miles to the east and as much to the north. Its geographical centre is not far from the Meteorological Observatory, on Bloor street West, which is in lat. 43° 40′ 0.8″ and long. 79° 23′ 54″. Toronto is situated on the north shore of lake Ontario about forty miles from its western end.

In discussing the geology of the region, it will be advisable to include the suburbs of the city as far east as Highland creek, 13 miles from the Don, and as far north as York Mills, 6 miles from Toronto bay.

Physiographically, the region may be divided into two parts, a terrace formed by ancient lake Iroquois, sloping gently upwards from lake Ontario to a height of 176 to 200 feet, and a somewhat higher upland formed of rolling hills of glacial origin, reaching at its highest points 380 feet above the lake, which is 246 feet above the sea.

The comparatively level surfaces of the terrace and the morainic region beyond are broken by the deep valleys of the Don and Humber rivers and their tributaries, which have been cut almost to base level for a mile or two from the shore and ramify as steep walled ravines for several miles inland.

The lake shore is greatly varied, including the flat sand and gravel spit which projects westwards from the Don and then bends northward to enclose Toronto bay, as well as the cliffs of Scarboro heights to the east, which rise 355 feet above the water and form the highest point on the whole shore of lake Ontario. This line of cliffs, extending for nine and a half miles, has been carved by wave action from an ancient promontory and has provided the materials which have been transported ten miles west by the easterly storms to build up Toronto island.

The vicinity of Toronto includes only small outcrops of solid rock, Lorraine shale of Ordovician age; but has a varied and interesting series of Pleistocene deposits unequalled in complexity and importance by any other North American locality. Its thick series of interglacial beds, the Toronto Formation, gives evidence of an interglacial time far longer than the post-glacial period and with a warmer climate than that of the present.

The geological succession may be arranged as follows:

Recent—River and lake Deposits.
Pleistocene
  Iroquois Beach Materials.
  Glacial complex (four beds of till with interstratified clay and sand).
  Toronto Interglacial Formation (Scarboro beds, Don beds).
  Earliest Boulder clay.
Palæozoic—Lorraine shale.

These will be described in succession from below upwards.

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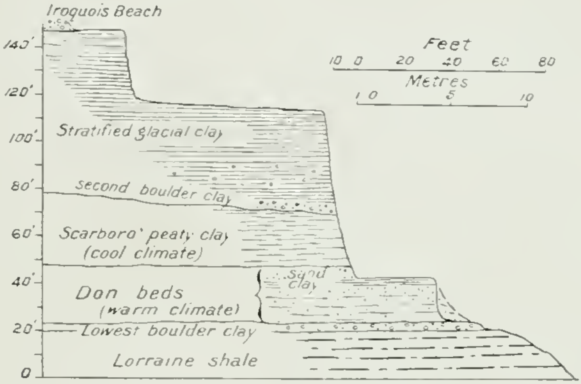
[1] This article and the one following (page 256), entitled "Moraines North of Toronto," descriptive of the glacial geology of Toronto and neighborhood, by Dr. A. P. Coleman and Mr. Frank B. Taylor respectively, were prepared for the use of the International Geological Congress which met in Toronto in August, 1913, and were published in Guide Book No. 6 for the excursions of that Congress. They are of more than fugitive interest and importance, and are accordingly reprinted in this Report so as to be available for future reference.

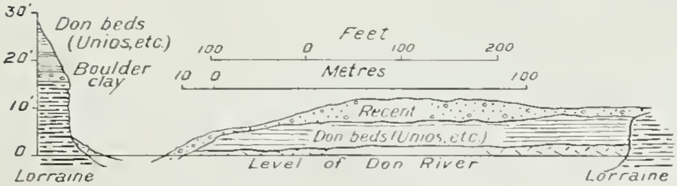
The Lorrain Shale

The bed rock of Lorraine shale (Ordovician or Lower Silurian) is generally buried under the drift deposits of the Pleistocene and comes to the surface at comparatively few points and in a quite inconspicuous way. Along the western lake front on Humber bay there are low outcrops rising not more than two or three feet above the water at Exhibition park and west of the Humber river. The shale rises higher along the sides of the river valleys, forming cliffs that reach 30 or 40 feet within the first three or four miles up the Humber, and 10 to 16 feet at the "Bend of the Don," about two miles from the mouth of the river.

All of these natural outcrops are greatly weathered, as might be expected in so easily attacked a rock as shale, and only the harder limey or sandy layers resist the action of rain and frost.



Section at Don Valley Brickyard, Toronto.



Section at Bend of Don River.

Artificial exposures in connection with the brickyards give the best opportunities to study the unweathered rock, the one most easily reached being at the Don Valley brickyard, where a great open pit from which shale is being quarried shows 60 feet of the formation. There are thin seams of impure limestone at frequent intervals in the shale and these have to be selected out before it is crushed for brickmaking. The weathered surfaces of the discarded limestones provide the best fossils in the Don region. The brickyard may be reached by taking a Church street car to Glen road, walking north to Binscarth road and then east to the edge of the Don valley, where a path leads down to the shale pit.

There are numerous exposures of the shale along the Humber, extending from near lake Ontario to Lambton Mills, two and a half miles up. The best outcrop for a study is just south of the bridge over the Humber at Lambton, where the river flows rapidly over the harder beds, many slabs of which are exposed along its shores. Here, in addition to the limestone layers, there are well ripplemarked sheets of shaly sandstone. The surfaces of the slabs display not only fossils, but a variety of markings supposed to be due to physical causes.

About two miles farther up the valley on the west side, there is a large shale pit from which materials are got for the manufacture of paving brick. This also affords a good collecting ground. The Lambton outcrops may be reached by taking a Dundas street car to the end of its route and then a Lambton suburban car to Lambton Mills.

The fossils found on the Humber differ somewhat from those at the Don brickyard, as determined by Prof. Parks, the western shale belonging to a somewhat higher horizon owing to a gentle southwesterly dip of the beds. Many of the fossils, however, are common to the two localities, and they are not separated in the list prepared by Prof. Parks. The most striking fossil is *Isotelus maximus* (sometimes called *Asaphus platycephalus*), which is occasionally ten inches in length. The fauna of the Don beds contains some species typical of the Eden of Ohio, while the Humber beds more closely resemble the Lorraine of New York.

List of fossils at Toronto:

Hydrozoa:—
Diplograptus pristis, Hisinger.

Echinoderms:—
Glyptocrinus decadactylus, Hall.
Heterocrinus juvenis, Hall.
Iocrinus subcrassus, M. and W.
Palasterina rugosa, Bill.

Vermes:—
Nereidavus varians, Grinnell.

Brachiopods:—
Leptæna rhomboidalis, Wilckens.
Rafinesquina alternata, Emmons.
Plectambonites sericeus, Sowerby.
Schizocrania filosa, Hall.
Zygospira modesta, Conrad.
Catazyga erratica, Hall.
Dalmanella testudinaria, Dalman.
Lingula, sp.
Trematis millepunctata, Hall.
Schizambon cf. *lockei*, W. and S.

Gastropods:—
Crytolites ornatus, Conrad.
Lophospira cf. *perangulata*, Hall.
Protowarthia cancellata, Hall.
Archinacella, sp.

Pelecypoda:—
Byssonychia grandis, Ulrich.
Byssonychia radiata, Hall.
Byssonychia imbricata, Ulrich.
Byssonychia alveolata, Ulrich.
Whiteavesia pholadiformis, Ulrich.
Modiolopsis concentrica, Hall and W.
Modiolopsis modiolaris, Conrad.
Cymatonota recta, Ulr.
Cymatonota pholadis, Ulr.

Orthodesma parallelum. Hall.
Orthodesma parvum, Ulr.
Lydrodesma poststriatum. Emmons.
Whitella hindi, Bill.
Whitella ventricosa, Ulr.
Cleidophorus neglectus, Hall.
Psiloconcha inornata, Ulr.
Modiolodon obtusus, Ulr.
Pterinea demissa, Hall.
Ctenodonta cf. *carinata*, Ulr.

Cephalopoda:—
Orthoceras crebriseptum, Hall.
Endoceras proteiforme, Hall.

Pteropods:—
Conularia formosa. Miller and Dyer.
Tentaculites starlingensis, Meek.

Bryozoa:—
Heterotrypa frondosa, D'Orbigny.
Heterotrypa inflecta, Ulr.
Monotrypa undulata hemispherica. James.
Amplexopora discoidea, Nicholson.
Bythopora delicatula. Nich.
Leptotrypa irregularis, Ulr.
Arthropora schafferi, Ulr.
Peronopora vera. Ulr.
Spatiopora cf. *maculosa*, Ulr.
Atactopora maculata, Ulr.
Dekayella ulrichi, Nich.
Bythopora arctipora. Nich.
Aspidopora, sp.
Paleschara beani. James.
Chiloporella. sp.
Callopora subplana, Ulr.
Callopora dalei, M-E and H.
Bythopora gracilis. Nich.
Hemiphragma whitfieldi. James.

Trilobites:—
Isotelus maximus. Locke.
Calymene callicephala. Green.
Trinucleus concentricus, Eaton.

Pleistocene Beds

The surface of the shale beneath the city had a high relief before the first Pleistocene ice sheet moved down upon it. A wide valley had been carved 200 feet below the general level by a great river which flowed south from the present Georgian bay region, the Laurentian river of Dr. Spencer. Probably a thick layer of preglacial weathered material once covered the surface, as the region is supposed to have been dry land since Palæozoic times, but this was completely swept away, perhaps by the advancing ice, leaving no record between the Ordovician and the end of the Pliocene.

Immediately upon the ancient marine shale one finds a sheet of boulder clay formed by land ice; and succeeding it in some places there are four other till sheets, each separated from the one below by interglacial beds of stratified gravel, sand and clay, piled up at Scarboro' to a thickness of nearly 400 feet.

The earliest and most important interglacial series includes 185 feet of delta deposits; but the later ones are seldom more than 30 or 40 feet in thickness, and may represent relatively short recessions of the ice. The retreat of each ice sheet in the series was doubtless followed up by a great glacial lake in which stratified deposits were formed. That of the latest (Wisconsin) ice sheet was accompanied by the waters of lake Iroquois, which lasted for thousands of years and left behind the terrace and gravel bars and shore cliffs which are such marked physiographic features at Toronto.

The earliest sheet of till consists of tough blue clay, evidently made largely from the local shale, and containing many angular slabs of its harder layers picked up close by. With them occur some well rounded polished and striated boulders of blue Trenton limestone, smaller boulders of black Utica shale, and many large or small boulders of granite, gneiss, greenstone or schist from the Archæan. No smoothed or striated surface has been found beneath the lowest boulder clay, which seems to pass down into the disturbed Lorraine shale; but the direction of the ice motion is indicated by the boulders of Utica and Trenton rocks, which are found in place in eastern Ontario.

The lowest boulder clay is usually not more than three or four feet thick, and in a few places it is wanting, having been swept away by interglacial rivers. Its best exposure is in a shore cliff near the west end of King street in Parkdale, where it rises four or five feet above the lake and is capped for 800 feet by a well-laid boulder pavement. Above the pavement there are 25 or 30 feet of less solid till formed by the next ice advance, with no interglacial beds intervening.

The flat upper surfaces of the stones in the boulder pavement are usually well and uniformly striated, the direction ranging from 290° to 315° with an average of 300°. The striæ run 30° north of west instead of south of west, as might have been expected. The glacial lobe which had followed the depression of lake Ontario from the east began to spread out towards its west end. A similar boulder pavement occurs in a shore cliff near Port Credit ten miles to the west.

Such boulder pavements imply a long interval between the two ice sheets in which the weather or running water or more probably wave action could remove the clay and allow the boulders to accumulate on the surface. The second ice sheet must have come on gently at first until the boulders were firmly sunk into the clay below, so as to withstand the later grinding, polishing and striation.

The Toronto Formation

After the recession of the first ice sheet, there was a long period of erosion and river action, in places removing the boulder clay and cutting down into the shale. Afterwards a great lake filled the basin, laying down the beds of clay, sand and gravel of the Toronto Formation upon the eroded surface.

The Toronto Formation is naturally divided into two parts, the lower being the Don beds and the upper the Scarboro beds. These two divisions differ greatly in their fossils and were formed under different climatic conditions, the Don beds including fossils proving a warmer climate than the present and the Scarboro' beds others that indicate a cooler climate. The two are never well displayed in the same exposure, but the order of succession is certain, and there are places which show the Don beds underlying conformably the lowest portion of the Scarboro' beds. Both were probably delta deposits, though of different types; but in the western part of Toronto there are interglacial beds having the tumultous cross bedding and irregularity characteristic of strong currents and probably formed by a large river. The exact position of these beds with reference to the others is not quite certain, though they belong to the same interglacial period.

The Don Beds

The best outcrop of the Don beds is to be found just north of the shale pit referred to before in the Don Valley brickyard, to the east of Rosedale. The Pleistocene section is 130 feet in thickness and includes not only the Don beds, but an overlying series of unfossiliferous clays which were formed much later when the ice front was not far off. The section is divided into three parts corresponding to the three working levels of the clay pit, and rises to the Iroquois terrace.

Resting on the shale there are three feet of boulder clay, followed by from 14 to 17 feet of stratified materials, consisting of a foot or two of bluish clay below and brown or yellow sand with thinner clay beds above, the whole somewhat irregularly distributed probably by a river coming into a lake 60 feet higher than lake Ontario at present.

This exposure is highly fossiliferous, some beds being crowded with shells, while flattened trunks and branches of trees often occur, and in one thin layer of clay, now run out, many leaves of trees have been found.

Ascending above this part of the section one must go about 50 feet farther north to find its continuation. The next bed is of blue clay $3\frac{1}{2}$ feet thick above which there are five feet of yellow and brown sand, the last member of the characteristic Don beds. The total thickness above the lower boulder clay is from 23 to 25 feet. The brown sand was evidently deposited in shallow water where oxidation was taking place, since some of the coarser beds of gravelly sand in the section are cemented with limonite.

Interglacial Beds at Bend of Don River.

Bluish gray finely laminated clay, overlying the Don beds conformably to a thickness of from 7 to 22 feet, was laid down in much deeper water, and shows no fossils except a little peaty matter. It represents the lowest part of the Scarboro beds.

A thin sheet of boulder clay, the second in order, rests upon the eroded surface of the stratified clay just mentioned, followed by 80 feet of rather coarsely laminated clay sometimes containing subangular striated stones. The source from which this clay was derived must have been the ice margin not many miles away. The lower stratified clay, which is interglacial, is formed of well leached material and burns to red brick; while the overlying stratified clay is so strongly charged with lime as to burn to a buff brick.

The top of the section consists of a few feet of brown sand and loam with large boulders, resulting from the wave work of lake Iroquois. The stones have evidently been washed out of an overlying sheet of till, which may still be seen in the old shore cliff half a mile to the north.

The lower 25 feet of Don interglacial beds are crowded with fossils and form the most important part of the section. From them wood or leaves of thirty-two species of trees have been obtained and forty-one species of shell-fish, of which twelve are unios or anodons, in addition to undetermined beetles, cyprids, etc.

The following list of interglacial plants was supplied by the late Professor Penhallow:

Acer pleistocenicum.
" *spicatum.*
" *torontoniensis.*
Asimina triloba.
Carya alba.
Chamæcyparis sphæroidea.
Clethra alnifolia.
Cratægus punctata.
Cyperaceæ sp.
[*]*Drepanocladus capillifolius.*
Eriocaulon sp.
Festuca ovina.
Fraxinus quadrangulata.
" *sambucifolia.*
" *americana.*
Gleditschia donensis.
Hippuris vulgaris.
Hypnum sp.
Juniperus virginiana.
Larix americana.
Maclura aurantiaca.
Ostrya virginica.
Picea nigra.
" sp.
Pinus strobus.
Platanus occidentalis.
Populus balsamifera.
" *grandidentata.*
Prunus sp.
Robinia pseudacacia.
Quercus obtusiloba.
" *alba* (?).
" *rubra.*
" *tinctoria.*
" *oblongifolia.*
" *macrocarpa.*
" *acuminata.*
Salix sp.
Taxus canadensis.
Thuya occidentalis.
Tilia americana.
Ulmus americana.
" *racemosa.*
Vaccinium uliginosum.
Chara.

Inadvertently he included two specimens from the Scarboro beds some miles to the east, *Picea nigra* and *Larix americana*, belonging to a later and cooler stage of the interglacial period.

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[*] Determined by Mr. A. J. Grout.

The shell-fish were determined a number of years ago by Dr. Dall and his assistants at the Smithsonian institution, the list being as follows:—

Unio undulatus
" *rectus* } Still living in lake Ontario.
" *luteolus*
" *gibbosus*
" *phaseolus*
" *trigonus* } Still living in lake Erie, but not reported from lake Ontario.
" *coccineus*
" *occidens*
" *solidus* } Not known in the St. Lawrence system of waters, but living farther
" *clavus* south.
" *pyramidata*

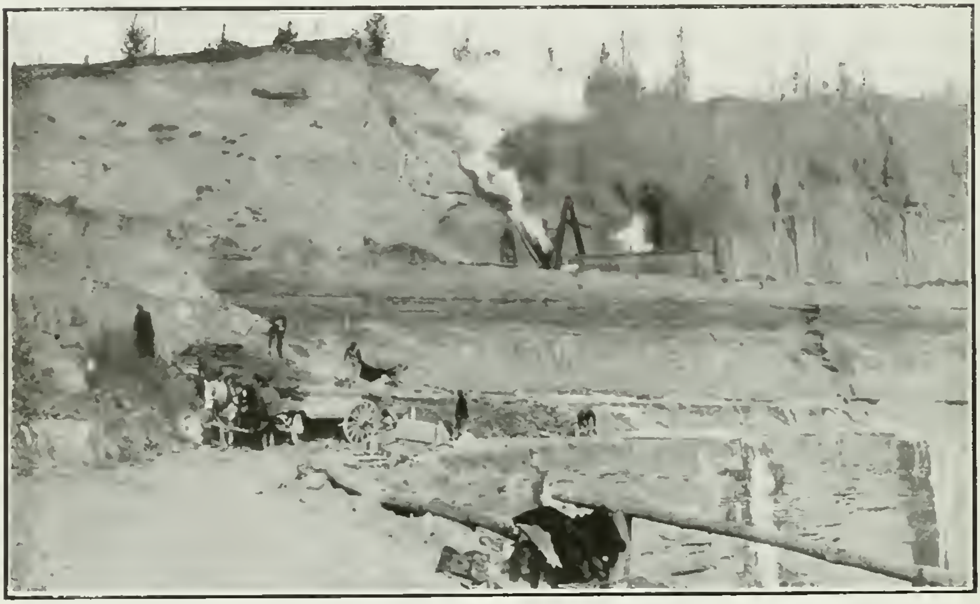
Anodonta grandis.—Not reported from Canada.
Sphærium rhomboideum.
" *similis* (?).
" *solidulum.*
" *striatinum.*
" *sulcatum.*
Pisidium adamsi.
" *compressum.*
" *novaboracense* (?).
Pleurocera subulare.
" *elevatum.*
" *lewisi* (?).
Goniobasis depygis.
" *haldemane.*
Limnæa decidiosa.
" *elodes.*
" *bicarinatus.*
Planorbis parvus.
Amnicola limosa.
" *porata.*
" *sagana.*
" *ancillaria.*
Physa heterostropha.
Succinea avara.
Bithinella obtusa.
Somatogyrus isogonus.
Valvata sincera.
" *tricarinata.*
Campeloma decisa.
Bifidaria armata (land snail).

Of mammals the Don Valley brickyard has supplied a bone of a large bear and bones or horns of bison, of a deer like the Virginia red deer, and of a deer related to the caribou.

Of the trees, seventeen are near their northern limit and scarcely reach Toronto at present, while ten or eleven of the unios and other shell-fish do not now live in lake Ontario, but inhabit Mississippi waters. The whole assemblage of plants and animals implies a warmer climate than the present, such as that of Ohio or Pennsylvania, as suggested by Prof. Penhallow and Mr. White. There could have been no great ice sheet within hundreds of miles of the region when the rich Don forest grew, with its pawpaws, osage oranges and red cedars.

A walk of half a mile up the Don valley to a second brickyard, just beyond a bend of the river, discloses another section of the Don beds of a somewhat different kind. To the west of the valley Lorraine shale rises 16 feet above the river, followed by boulder clay, on which rests sand with unios like the deposits just described. Two hundred yards to the east the shale can be seen rising eight or ten feet, but between these two points the boulder clay and shale were cut away by an interglacial river, which afterwards began to deposit materials on the shale in the rising waters of a lake.

At the base of the section there are three or four feet of coarse shingle mixed with matted reeds, leaves and wood. Above this there are eleven feet of sand and clay with many shells. The whole is covered by a few feet of recent sand deposited by the Don before its bed had been cut as low as at present. The trees include red cedar, elm, oak and pawpaw, showing that the climate was warm at the earliest stage of the Don beds.



Don Valley Brickyard.

If we add these lower beds to the better exposed section at the Don valley brickyard, the total thickness is 40 or 45 feet.

Similar beds of sand and clay containing wood and unios are found at several places along the Don for about two miles to the south, and wood and shells have been obtained from excavations and wells at many points in the city to the west and below the level of the lake at Scarboro also, so that the Don beds cover several square miles, though the exact boundaries are not known.

A deposit of sand and gravel containing wood and shells has been found near Thornhill, fourteen miles north of lake Ontario, while boring for water. It underlies 200 or 300 feet of clay, and is no doubt the northward extension of the Don beds along the channel of the interglacial river which formed the delta

The Scarboro Beds

The upper interglacial beds at the Don valley brickyard, consisting of laminated clay with no fossils except peaty materials, are found at several outcrops to the north and northwest, growing thicker in those directions and reaching, north of Reservoir park, an elevation of about 150 feet above lake Ontario. They are also found to the east of the Don and at Scarboro heights, where they are best exposed. In the brickyard 672 laminæ were counted in a height of 19 feet 9 inches, probably representing as many years of deposition. Above this a foot or two were too much broken up by the later ice advance to be counted. The counting was done by Baron de Geer's method, devised for the marine clays of Sweden, the limits of the layers being marked on strips of paper.

Since the Scarboro cliffs give the best opportunities for the study of these beds, they will be described as typical. The splendid Scarboro section was worked out by Dr. George Jennings Hinde many years ago, demonstrating the first series of interglacial beds recognized in America. His work was so good as to require scarcely any change in later times. At Scarboro the Don beds are not visible in the cliffs, but wells sunk on the beach show that they exist a few feet below the lake and have a thickness of 36 feet. They consist of yellowish sand with some beds of clay, containing unios and pieces of wood as in the Don sections.

Above the water level, where the interglacial section is most complete, there is not only laminated clay like that referred to above, but also a great thickness of sand resting upon it.

The thickest section includes 36 feet of Don beds and 5 feet of peaty clay below water, with 85 feet of peaty clay above water followed by 55 or 60 feet of stratified sand, making in all 186 feet of interglacial beds. The general section shown in the cliffs will be described first, and then the fossils will be taken up.

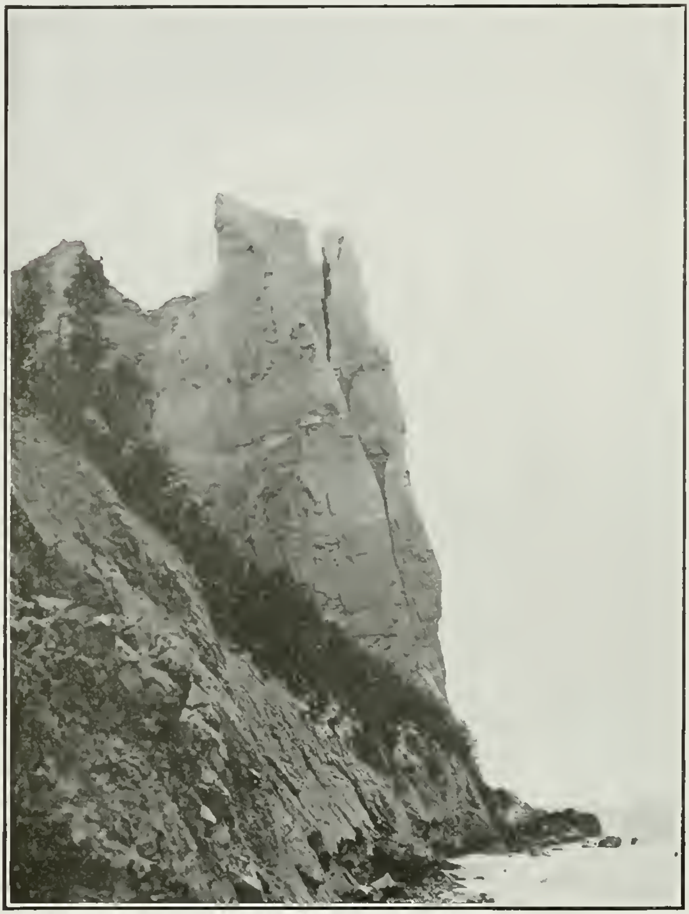
The Scarboro Section

At Victoria park, toward the east end of Toronto, the flat sandy shore ends and boulder clay shows above the water, standing up as a comparatively low cliff capped with Iroquois sand beds. Toward the east the cliff rises and becomes more complex in structure until it reaches a height of 355 feet four miles from Victoria park, after which it descends and finally reaches lake level at Highland creek, 9½ miles from its commencement. This fine section shows not only the greater part of the interglacial beds, but a series of four tills with interbedded stratified sand and clay, and also nearly 100 feet of Iroquois sands towards the western end. The upper series of boulder clays and interstratified beds is confined to a small part of the section at its highest point. To the east and west of this only one sheet of boulder clay can be seen, but it stretches almost continuously along the upper part of the section, though with great variations in thickness.

It is evident that the interglacial beds were greatly eroded by river action before the second ice advance, as may be seen at the " Dutch Church," where a river valley was cut to a depth of 166 feet, having a width of 1,200 feet at lake level and nearly a mile on top. The layer of boulder clay, after rising to 150 feet, rapidly dips down to the level of the lake at this point and then rises again beyond it. This is in reality the second sheet of till in the succession, the lowest one being 40 feet below the lake, underlying the unio beds mentioned above.

The waves of lake Ontario undercut the cliff, especially in seasons of high water, after which slices slip down and are removed by storms. Where there are several successive years of low water in the lake much of the face of the cliffs becomes covered with vegetation, though they are too vertical in the neighborhood of the Dutch Church to permit of much plant growth. The earliest reliable survey of Scarboro was made fifty years ago, and another survey made during the past year shows an annual recession of 1.62 feet per annum. The boulders from the boulder clay remain at the base of the cliff, when not removed by man, and the interglacial sands when washed by the waves on the shore show thin sheets of red garnet or black magnetite.

The interglacial clay rising about 85 feet above the lake has certain well marked features. It is often well stratified in laminæ running from a fraction of an inch to two or three inches in thickness, though there are a few layers three or four feet thick in which the bedding is indistinct or wanting. Where typically bedded each lamina consists of a darker layer of fine gray clay, and a paler part of a silty nature. Often the silty part widens and contains more or less peaty matter with mica scales. Occasionally the peaty bands expand to half an inch or an inch in thickness, and rarely twigs or small bits of wood are found. Every few feet in the section shows a thin sheet of impure siderite which stands the weather better than the rest of the beds and is broken on the beach into flat shingly pebbles, which slowly oxidize to limonite. The iron ore and the peaty layers make distinctive features by which this interglacial clay is easily recognized. It burns to a red brick.



The "Dutch Church," Scarboro.

From the peaty matter mosses, bits of leaves and bark, seeds and parts of beetles may be obtained, by washing away the clay, drying the peat and examining it with a lens. The late Dr. Scudder, of Harvard University, determined seventy-two species of beetles from materials obtained here, the list being as follows:—

Fauna of Cool Climate, Chiefly from Scarboro

Arthropoda (almost wholly beetles):
Carabidæ (9 gen. 34 sp.).
    Elaphrus irregularis.
    Loricera glacialis.
        " *lutosa.*
        " *exita.*

Nebria abstracta.
Bembidium glaciatum.
" *Haywardi.*
" *vestigium.*
" *vanum.*
Bembidium præteritum.
" *expletum.*
" *damnosum.*
Patrobus gelatus.
" *decessus.*
" *frigidus.*
Pterostichus abrogatus.
" *destitutus.*
" *fractus.*
" *destructus.*
" *gelidus.*
" *depletus.*
Badister antecursor.
Platynus casus.
" *Hindei.*
" *Halli.*
" *dissipatus.*
" *desuetus.*
" *Hartii.*
" *delapidatus.*
" *exterminatus.*
" *interglacialis.*
" *interitus.*
" *longævus.*
Harpalus conditus
Dytiscidæ (3 gen. 8 sp.).
Coelambus derelictus.
" *cribrarius.*
" *infernalis.*
" *disjectus.*
Hydroporus inanimatus.
" *inundatus.*
" *sectus.*
Agabus perditus.
Gyrinidæ (1 sp.).
Gyrinus confinis, LeG.
Hydrophilidæ (1 sp.).
Cymbiodyta exstincta.
Staphylinidæ (11 gen. 19 sp.).
Gymnusa absens.
Quedius deperditus.
Philonthus claudus.
Cryptobium detectum.
" *cinctum.*
Lathrobium interglaciale.
" *antiquatum.*
" *debilitatum.*
" *exesum.*
" *inhibitum.*
" *frustum.*

Oxyporus stiriacus.
Bledius glaciatus.
Geodromicus stiricidii.
Acidota crenata, Fabr. (var. *nigra.*).
Arpedium stillicidii.
Olophrum celatum.
" *arcanum.*
" *dejectum.*
Chrysomelidæ (1 gen. 2 sp.).
Donacia stiria.
" *pompatica.*
Curculionidæ (4 gen. 6 sp.).
Erycus consumptus.
Anthonomus eversus.
" *fossilis.*
" *lapsus.*
Orchestes avus.
Centrinus disjunctus.
Scolytidæ (1 sp.).
Phloeosinus squalidens.

Of these all but two are extinct. as stated by Dr. Scudder.

Mr. A. J. Grout has determined the following mosses from the same beds:—*Hygrohypnum palustre* (?), *Drepanocladus vernicosus* (Lindb), and *Hylocomium* sp.

The Scarboro interglacial sands are less extensive than the clays just described, since they are the uppermost beds and suffered far more from superficial destruction by rain action and river erosion in the later part of the interglacial interval.

Where best developed the sands have a thickness of 55 or 60 feet, the lower four or five feet having clayey layers showing a transition to the peaty clay. The sand is generally coarse, but free from pebbles, and some layers are cross-bedded, showing that the deposit was made in shallow water. There are in some places many concretions of brown iron ore, once no doubt, siderite.

Toward the bottom of the sand and immediately above the clay there is often a thick bed of coarse peaty materials, including many chips of wood and bark and bits of branches. The trees recognized are *Larix Americana* and *Abies balsamea.* A few small shell-fish are found also, *Sphærium rhomboideum*, *S. fabale*, *Limnæa* sp., *Planorbis* sp. and *Valvata tricarinata.*

The sand extends for five miles along the cliffs and has been found in ravines several miles north of the shore.

The Scarboro interglacial beds were formed in a northern bay of an interglacial lake, which reached at least ten miles inland from the present shore. They are delta deposits laid down by a great river coming from the Georgian bay region, draining the basins of the present upper lakes, and they began with a water level somewhat below that of lake Ontario.

Above the second till sheet there is stratified clay and sand, followed by a third sheet of till, and in the highest part of the cliffs a fourth and a fifth sheet of boulder clay have been found with intervening stratified sands and clays. There were three well-defined recessions of the ice during which lake deposits having thicknesses of from 25 to 36 feet were deposited. How long these later interglacial periods lasted is unknown. No important erosion intervals are known in connection with them, and except for a few small shells in one of the beds they are without fossils; so that they seem to have been of much less importance than the Toronto interglacial period.

The total thickness of these upper glacial and interglacial deposits at the highest point of the Scarboro section is 203 feet.

The magnificent Scarboro section may be seen to the best advantage by taking a King street car as far east as possible and then walking eastwards along the shore. This, however, demands a good deal of time, and the highest and most interesting parts of the section may be seen more expeditiously by taking a King street car to the Woodbine and there transferring to a suburban car running along Kingston road. This ascends the sandy slopes of the long spit which enclosed the ancient Don bay of lake Iroquois, and then runs for two miles east along the old gravel bar, which is well disclosed by numerous gravel pits. The road then climbs the Iroquois shore cliff to the gently rolling upland of boulder clay. At stop 32 a lane leads south from Kingston road past a Topographical Survey tower to the edge of the cliff, a distance of about three-quarters of a mile. The highest point on the actual shore of lake Ontario is reached a short distance to the east. From this point, 355 feet above the lake, there is a steep descent, mostly through a small growth of trees to the shore. The section described above is shown in bare cliffs on each side of the path, a sheet of boulder clay, followed by stratified clay and sand, another sheet of boulder clay, succeeded by silty sand with its upper layers crumpled by the advancing ice, a third comparatively thin sheet of boulder clay with cross-bedded sand beneath it, and a fourth boulder clay resting on the eroded sand beds of the great interglacial formation, under which the peaty clay extends to the shore of lake Ontario.

The section has been worked out as follows:

		Feet.	
Boulder clay, No. 5		48	Glacial Complex, 203 ft.
Stratified sand and clay		36	
Boulder clay, No. 4		32	
Silty sand, upper layers crumpled		25	
Boulder clay, No. 3		9	
Cross-bedded sand		29	
Boulder clay, No. 2		24	
Scarboro Interglacial beds	Sand	59	Above level of lake Ontario, 151 ft.
	Peaty clay	92	
Don beds (unios and wood)	Peaty clay	5	Below level of Lake Ontario, 41 feet.
		36	
Boulder clay, No. 1			
Lorraine shale			
Total Pleistocene beds		395	

A walk of less than a mile westwards along the beach brings one to the "Dutch Church," where an interglacial river valley has been filled with the second boulder clay followed by stratified glacial clay. The gradual rise of the boulder clay on each side of the fossil valley is well exposed.

The steepest cliffs of the section are cut from this thick mass of hard clay which stands vertical to a height of 150 feet. Small streams coming in have cut extraordinary ravines, one of them with the aid of rain erosion shaping the tower and buttresses of the "church." A stairway leads up 170 feet from the shore at the Dutch Church to the Iroquois terrace, here beautifully displayed with a shore cliff more than 100 feet high; and a walk of three-quarters of a mile brings one to the Kingston road, at Halfway House, where a car may be taken to the city.

Interglacial Beds in the Western Part of Toronto

The order of succession and relative ages of the deposits thus far described are well ascertained, but in the western part of Toronto, north of Bloor street and near Christie and Shaw streets, there are fossiliferous beds of uncertain position. Eighty feet of tumultuously cross-bedded sands and gravels here underlie the second till sheet, so that they are clearly interglacial; but they differ so much in character from both the Don and Scarboro beds that they cannot be classed with either. They were evidently formed by a powerful river which sometimes deposited coarse materials in its bed and then cut them away again by some shifting of its channels, a type of work quite different from the quiet deposit of clay and sand in the interglacial delta of the Don and Scarboro sections. They may be older than the Don beds or younger than the Scarboro beds.

These western beds contain a few fragments of unios as well as *Sphæriums*, *Pleuroceras* and other small shells, all of which occur in the Don beds. A little wood found in these sand pits is still undetermined. The most interesting fossils obtained are scattered bones of mammals, including bison, deer and mammoth or mastodon. A horn of *Cervalces borealis*, as determined by Prof. Bensley, an atlas vertebra of bison and part of a lower jaw of a bear (O. P. Hay) have been found also, and several fragments of ivory have been picked up. All of these remains seem to have been waterworn and may have been transported for some distance. There is no certain evidence as to climate in the fossils thus far found.

Shaw Street Sand Pit.

From the lists given above it will be seen that the Toronto Formation has furnished a wide range of fossils, including 42 trees and other flowering plants with several mosses, 41 shell-fish, 72 insects, and 5 or 6 mammals—about 165 or 170 species all told.

Outline of Climatic and Physical Changes

The Toronto interglacial period included great changes in climate and in physiographic features. During the retreat of the first ice sheet no doubt the climate slowly changed from Arctic to subarctic and finally to temperate, and probably the valley was at first occupied by a great glacial lake when thawing had proceeded so far as to free the basin, but not its outlet toward the northeast. These earlier stages of the interglacial time have left no visible record, though they must have required thousands of years to accomplish.

The first episode in the Don beds shows a river flowing into a lake lower than the present, with a rich deciduous forest on its shores. There followed a rise of water in the lake, probably by the upwarping of its outlet, to 60 feet above the present level. This time of warm climate lasted long enough for the deposit of 45 feet of sand and clay in a delta several square miles in area, and for the growth of generations of forest trees.

At length there came a rise of the waters to 150 feet or more above the present lake, when delta beds were laid down covering more than 100 square miles. At one point there are 672 annual layers in less than 20 feet, so that the whole thickness must have required some thousands of years to deposit. The climate had become colder, as shown by the plants and insects, and was like that of northern Ontario at present.

Next, the great lake was drained to a level 16 feet below lake Ontario, and three river valleys were carved in the delta, a wide one toward the west at the present site of Toronto, a narrower one at the Dutch Church and another wide one towards Highland creek. These valleys had gently sloping sides and were much more mature than the present valleys of the Don and the Humber. To cut them the rivers must have required several thousand years.

Christie Street Sand Pit (Interglacial). Upper Boulder Clay to Right.

Finally, Arctic conditions came on and the ice advanced once more from the northeast, covering the eroded surface of the region with a second sheet of boulder clay. The climatic cycle was complete.

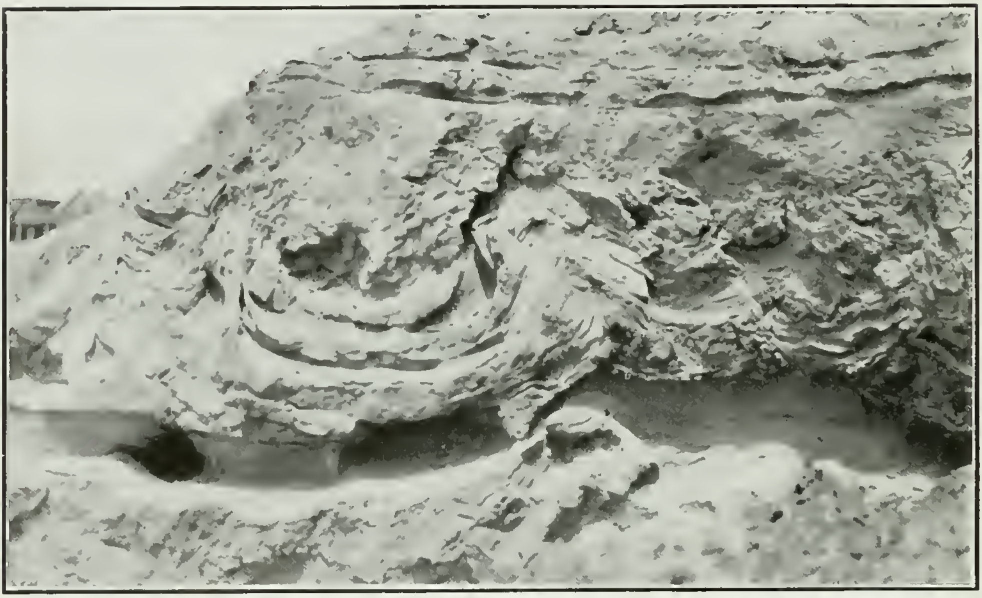
The Iroquois Beach Deposits

After the last ice age, when the retreat was well under way, the basin of lake Ontario was freed from ice while its outlet at the Thousand Islands was still blocked. The water escaped by the Rome outlet, in the state of New York, to the Hudson, and a lake which has been named Iroquois by Dr. Spencer, occupied the basin at a much higher level than that of lake Ontario. The southern slope of Toronto is largely covered with its deposits, the old shore cliff runs east and west through the city, and at each end a great gravel bar extends across the present river valley.

The Iroquois beach is deformed and rises from 176 feet above lake Ontario at the

Humber gravel bar toward the west to 196 feet at the York gravel bar crossing the mouth of the ancient Don bay, and to 200 feet at Scarboro heights. The shore cliff within the city north of Davenport road averages about 75 feet in height, but at Scarboro reaches in places 170 feet. At the highest point of the Scarboro cliff it is completely cut off by the shore of lake Ontario for half a mile, the only known point at which the waves of Ontario have encroached on the ancient shore line.

Lake Iroquois began its work at least 70 feet below its latest well marked beach, but none of the earlier stages is shown at Toronto. Beside the cutting of a terrace in the Pleistocene deposits with the cliff at its rear the lake did much work in distributing materials, filling in former depressions in the terrace, and building the two great gravel bars in west and east Toronto respectively. Each of these bars began on the east side of its bay and grew westwards, crowding the river out of its earlier channel and forcing it to the western shore of the bay.



Crumpled Beds (Iroquois Deposit) near Pape Avenue.

The bar in west Toronto crossing the Humber bay extends west as a uniform and rather narrow ridge of gravel and sand rising 20 feet above the slope to the south, while the York (or east Toronto) bar enclosing the Don bay is more spread out and contains lagoons. It had much the size and shape of the present Toronto island.

Both of these ancient bars are being rapidly destroyed, the sand and gravel being used for building purposes in Toronto.

The Iroquois deposits are sometimes 100 feet thick and include coarse materials in the gravel bars, sand of varying character on the lakeward slope, as well as silt and clay within the Don and Humber bays. At one point near Reservoir park shells have been found in the gravels, species of *Campeloma*, *Pleurocera* and *Sphærium*, all still living in lake Ontario. The commonest fossils are horns of caribou, which are often found in the west Toronto gravel bar. Less frequently teeth of mammoth have been obtained. The mammoth and the caribou suggest a cooler climate than the present. The caribou is essentially a northern animal, and has not been found within 150 miles north of Toronto during historic times. It is natural to suppose that the waters of lake Iroquois, which had a shore of ice toward the northeast, were colder than those of Ontario, and that the climate was cool, if not even subarctic.

When lake Iroquois was drained through the melting of the ice dam at the Thousand islands, the water sank to sea level, but there is no evidence of marine deposits on its shore. The marine episode was comparatively short and the water was probably kept fresh by the Niagara river. The outlet was still rising toward the northeast, so that the water was backed up toward the southwest end of the lake. On the lower reaches of both the Don and the Humber there is dead water owing to this rise of the lake level, and well borings near the mouth of the Don show 100 feet of stratified sand built up in the old channel. The growth of Toronto island is, however, the most evident work of lake Ontario near Toronto in recent times. Its materials have been transported westwards from Scarboro heights, and have been built out into deep water enclosing Toronto bay. The growth of the island has been shown by Sir Sandford Fleming, from a comparison of maps more than 100 years old, to have been extensive.

MORAINES NORTH OF TORONTO[1]

By Frank B. Taylor

The moraines to be visited on this excursion were made at a relatively late stage in the retreat of the last or Wisconsin ice sheet, and are the first moraines formed north of lake Ontario. One was made along the southern edge of the Trent valley-lake Simcoe ice lobe. At the locality visited the ice which made this moraine, was moving towards the south and the moraine faces in that direction. The main movement in that lobe, however, was towards the southwest, shown by the axes of many drumlins and drumloids and by striæ and the direction of boulder transportation in the Trent valley and lake Simcoe regions. The direction in this area was about the same during the maximum extent of the ice and during the whole time of its retreat. The other moraine to be visited lies close south of the first and was formed along the northern edge of the ice lobe which lay in the basin of lake Ontario.

At the greatest extent of the ice sheet, its front reached nearly to Cincinnati, Ohio, about 400 miles southwest from Toronto. The ice which reached this point was part of the great ice stream which moved southwestward through the basins of lakes Ontario and Erie. At the same time the ice front in a direction south-southeast from Toronto reached only to Salamanca, New York, about 120 miles from Toronto. This was on account of the Alleghany plateau, the high mass of which obstructed the southward movement in western New York and Pennsylvania and in northeastern Ohio, and turned the current towards the southwest along the axis of the lake basins. The central axis of the great ice stream passes about 30 miles south of Toronto, and there was not much change in its position during the retreating phase, until the ice front had receded to the northeast end of lake Erie. By the time it had reached this position, however, the relatively deep basin of lake Ontario became the controlling factor in the ice movements of this region. This was the position of the ice front a short time before the moraines to be visited were made. The ice field was then confluent and continuous over the whole region between the lake Ontario basin on the south and the Trent valley, the lake Simcoe basin and the basin of Georgian bay on the north. At this time the ice front rested against the face of the Niagara escarpment from Hamilton northward to Georgian bay, and the ice lay as an unbroken sheet over the whole region to the east. It was already growing thin, however, over the ridge north of Toronto, and with further steps of retreat the ice soon parted and the ridge began to emerge.

The first parting of the ice lobes in the manner described probably occurred during the time of lake Arkona, but was temporary, for the pronounced readvance of the ice to the Crystal beach (Alden, Port Huron) moraine carried the ice front back again to the base of the escarpment, and the moraines which had just been made were overridden and destroyed. This episode of glacial history is not established on evidence seen in the localities visited on this excursion, but is fully supported by facts recorded in other parts of Ontario and in Michigan and New York. Then, when the ice front retreated again, the ridge was once more uncovered and the moraines now seen on the heights 20 miles north of Toronto began to be formed. This was probably during the times of lakes Wayne and Warren, but later phases farther east were probably correlatives of lake Lundy.

The two moraines were formed on the top of the emerged ridge, first at the west end near the base of the Niagara escarpment, and later at places farther east. As the flanks of the ridge were gradually uncovered, lake waters stood high upon them, but these waters were only narrow arms that reached northward from the main lake in the basin of lake Erie and made no perceptible record by wave action.

At this stage of retreat the ice did not enter the western part of the lake Ontario basin over the ridge north of Toronto, but came in at the northeastern end chiefly in the gap between Trenton, Ontario, and Oswego, New York. At this time the lake Ontario ice lobe had become sharply differentiated, so that in the western half of the basin the ice was spreading from the central axis towards the margin on all sides except the east, where the ice stream was entering. From this circumstance it happens that the ice at this stage moved towards the northwest over Toronto and vicinity. A few miles east of Toronto its movement was directly north. These movements were respectively transverse and nearly opposite to the southwestward movements over this region at the time of maximum extension. The relations in this area afford a fine illustration of the changing and increasing influence of topography upon the movement of the ice as the ice grew thinner.

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[1] See footnote on p. 238 of this Report. The fact that this article was written primarily for the guidance of members of the International Geological Congress (August, 1913) explains the phraseology.

The drift, as Professor Coleman has pointed out, is quite deep in the vicinity of Toronto. But it is certainly much deeper along the line of the great moraines 20 miles to the north; and its depth is also considerable in the region west and southwest of lake Simcoe. Much the greater part of the deep drift in the region around Toronto is of pre-Wisconsin age, but beyond this general statement its precise age has not been determined even approximately, except by Coleman, in the remarkable exposures in Toronto.

Bond Lake, looking East. Probably due to partly buried Ice Block which afterwards melted out.

It is quite clear, however, that the pre-Wisconsin beds or some of them, have a wide extension in easterly, northerly and northwesterly directions from Toronto. In many localities the Wisconsin drift is only a thin sheet, sometimes even discontinuous, over a great mass of the older drift. The bulky moraines north of Toronto appear to rest upon a deep substructure of these older deposits.

Suburban cars leave the Toronto and York Radial station on North Yonge street. The station stands a little below the level of the beach of glacial lake Iroquois, and the car ascends the old lake cliff immediately after leaving the station. On reaching the top, the traveller finds himself on an undulating plain trenched by small streams running towards the southeast. The stream valleys have been cut to only moderate depths, the deepest being the west branch of the Don river, which at York Mills reaches a depth of about 100 feet.

The surface forms that meet the eye as soon as the car leaves the old lake bluff are readily recognized as products of glacial action, perhaps partly constructional, but mainly destructional in character—a smoothing and rounding off of an uneven surface by the ice sheet. In the first mile or two several hills resembling drumlins are seen, none of them perfect types, however, but sufficiently near to be called drumloid forms. Glacial action is not recorded alone in these hills, for the whole surface is characterized by long drumloid profiles on the interstream ridges, and the troughs have the same character, and both troughs and ridges are strongly aligned after the fashion of drumlins in the direction of the latest ice movement. This kind of surface has been happily characterized by Fairchild as "drumlinized," meaning by this that the drumlin-forming process gave the surface its character, although no perfect drumlins were formed.

At York Mills the sands in the high bank south of the Don river and west of the track are reported by Coleman to be of pre-Wisconsin age. Between York Mills and Richmond Hill several partially drumlinized forms are seen towards the east. At Thornhill a bored well penetrated 600 feet of drift, or about to sea level, before reaching rock. A large part of the material was reported to be sand.

A Pond and Morainic Topography in the Northern Moraine, looking South three miles West of Aurora.

Approaching the moraine north of Richmond Hill, the drumloid forms disappear and the plain merges smoothly into the southern slope of the moraine. This slope is notably smooth and lacks the hummocky surface which usually characterizes terminal moraines. The southern margin takes this form all along from King southward to Maple and then northeastward and eastward for 100 miles. This smooth slope is the side on which the ice front rested while building the moraine. The moraine, therefore, faces northwest and north, its north side being its front slope and its south side its rear.

On reaching the summit of the ridge this and the northward slope are found to be more irregular and hummocky than the south slope, more characteristic of ordinary terminal moraines. There are many knobs and basins, and within two miles there are three moraine lakes and several similar hollows that do not now contain lakes. The car line passes along the west side of Bond lake and the party will walk northward from the power house to Schomberg Junction, noting the very steep slopes bordering this lake and the rugged nature of the ground, and also the sections of the drift exposed along the newly-made highway. Much of the drift in the north slope of the moraine is more or less sandy, suggesting glacio-fluvial deposition, but no extensive bodies of outwash are associated with the moraine in this vicinity. The south or rear slope, in addition to the smoothness described above, is more generally composed of till and shows almost no evidence of glacio-fluvial action. Some of the lakes and basins are no doubt due merely to the irregular heaping of the drift during deposition by the ice, but some, like Bond lake, appear to mark the sites of ice blocks, surrounded or partly buried by drift, the lake basin remaining when the ice melted out.

From the Junction one looks to the north and west across a flat valley half a mile to a mile wide, and just beyond it lies a splendid moraine formed by ice moving southward over the lower region to the north. The flat valley is a narrow till plain lying between two moraines that face toward each other. It extends eastward from the Junction to Willcocks lake, which lies partly in the southern moraine, but mainly in the plain. The party will walk eastward from the Junction along the south side of the plain, gradually ascending the front of the southern moraine and passing along the south and east sides of the lake. From the lake shore the valley is seen to pass on towards the northeast and north. It extends in this direction for about a mile, where it appears to vanish into the air. But a glacial drainage course marked by a train of sandy gravel comes from the outwash area to the east and appears to connect with it. Northeast of the lake the valley has the character of a large drainage channel or old river bed lying between the two moraines, which form its banks on either side. In the early phase of this pause of the retreating ice, a large river issued from the narrow space between the two ice fronts and flowed out to the west. This river carried the accumulated drainage from a long way to the east and northeast. There are low sand and gravel beds on the valley floor north and northeast of the lake that record the action of the river.

Looking North over Willcocks Lake, the Northern Moraine in the distance.

The main bulk of the gravels, however, lies at a slightly lower level than the head of the channel, and marks a change of the drainage by which it continued along the rear side of the northern moraine to another slightly lower passage farther west. Such a passage occurs about eight miles west of Aurora or one mile east of Linton, and the gravels appear to end at that place. Outwash gravels form the crest of the hill along the north side of the creek for two miles west from Van Dorf.

These old river gravels form a sort of terrace along the north or rear slope of the north moraine. It is well defined where the electric line crosses it at the cemetery a mile south of Aurora.

The deposit stands considerably above the lower country to the north. It is cut by many small gullies, but is substantially continuous from the large outwash deposit six or seven miles east of Aurora to the gap east of Linton. This deposit is not outwash issued from the front of the ice while the moraine was being built, for it rests on the rear slope of the moraine. It appears to have been deposited by a river flowing westward along the ice front in the last or closing phase of the relatively long pause during which the moraine was built. The ice had ceased advancing apparently and had become practically inert along its edge. The river during this phase had fallen a little below the passage to Willcocks lake and probably escaped southward through the gap east of Linton.

Two miles east of Willcocks lake there are well-developed eskers and associated troughs cutting through the southern moraine from southeast to northwest. These also show with great clearness that the ice here was moving toward the northwest, normal to the trend of the moraine at this place. The esker stream cut through the moraine and issued into the drainage channel a mile and a half northeast of Willcocks lake.

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